INSTRUCTION MANUAL

Serial Number ____________

147/R147
NTSC TEST SIGNAL GENERATOR

Tektronix, Inc. ● P. O. Box 500 ● Beaverton, Oregon 97005 ● Phone 644-0161 ● Cables: Tektronix

070-1169-00

1171

WARRANTY

All Tektronix instruments are warranted against defective materials and workmanship for one year.

Any questions with respect to the warranty, mentioned above, should be taken up with your Tektronix Field Engineer or representative.

All requests for repairs and replacement parts should be directed to the Tektronix Field Office or representative in your area. This procedure will assure you the fastest possible service. Please include the instrument Type (or Part Number) and Serial or Model Number with all requests for parts or service.

Specifications and price change privileges reserved.

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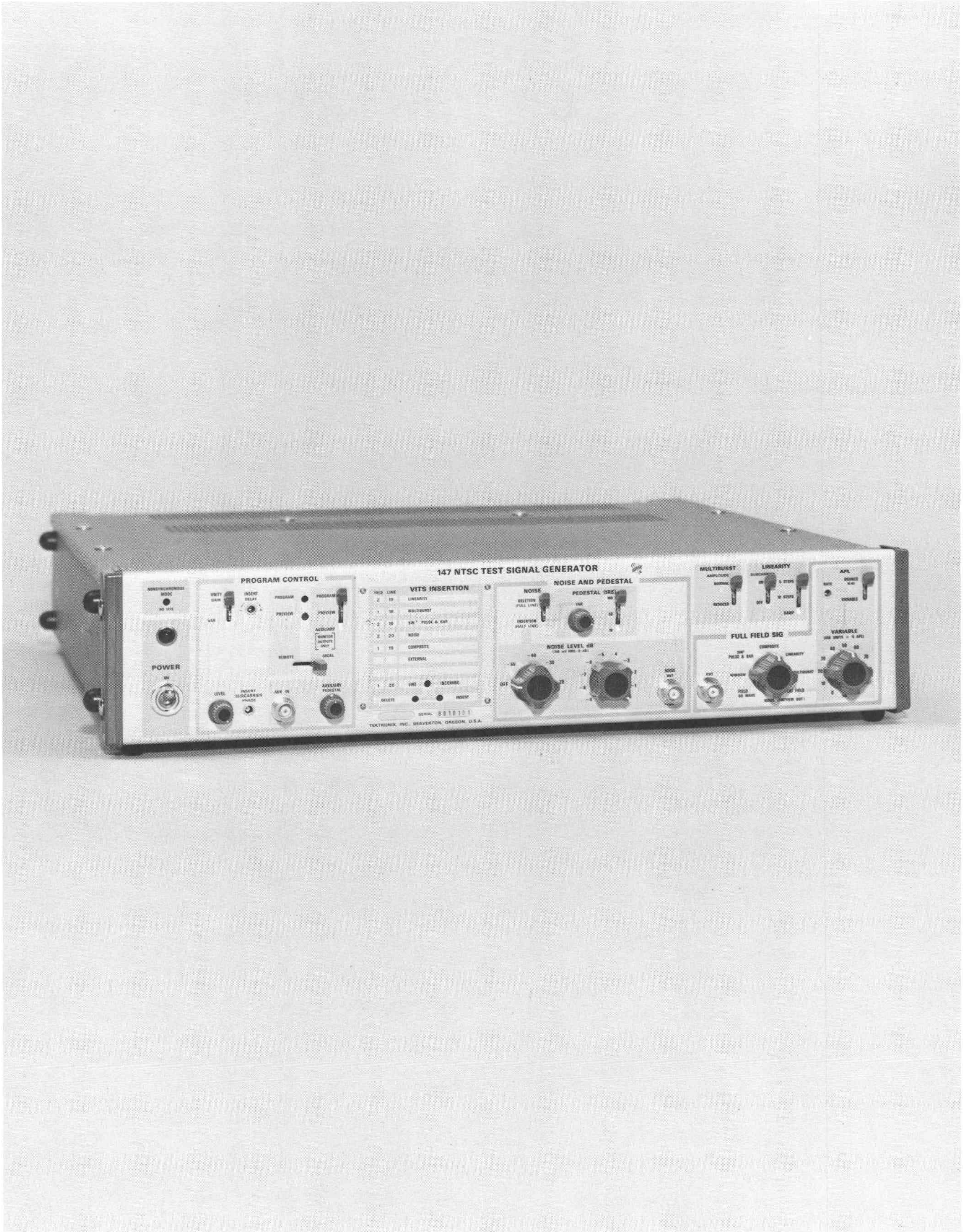


Fig. 1-1. The 147 NTSC Test Signal Generator.

SECTION 1 SPECIFICATION

General Information

The Tektronix 147 and R147 NTSC[1] Test Signal Generators[2] are compact, solid state instruments capable of supplying several test signals commonly used by the television industry for test and measurement of video transmission systems or discrete parts of the system. The generated signals are available as Full Field Composite Video test signals on one output, and as Vertical Interval Test Signals (VITS) inserted into the vertical blanking interval of an incoming composite video signal, appearing in combined form on another output.

In addition to the front-panel controls, there are extensive provisions within the instrument to permit selection of the test signal parameters and their time location within the vertical blanking interval. This flexibility is provided mainly through the use of pin connector changes, permitting simple and rapid change of selection without soldering procedures. All time locations of the test signals, within both the line and the field, are derived by digital counting from a master oscillator which, in turn, is locked to the incoming composite video if present. The 147 may be used in conjunction with a Type 140 NTSC Test Signal Generator to provide standard test signals with Gen-Lock[3] operation.

Available Signals

The 147 generates MULTIBURST, LINEARITY, FLAT FIELD, FIELD SQ WAVE, WINDOW, SIN^2 PULSE & BAR, COMPOSITE, and NOISE signals for use as Full Field Composite Video or VITS. The proposed VIRS (Vertical Interval Reference Signal) can be generated by the 147 and may be inserted on line 20 of either or both fields as internally programmed.

[1] **National Television System Committee.**

[2] **Since the 147 and R147 are electrically identical, the 147 will be used for all text and illustrations in this manual.**

[3] **Synchronization of signals in both frequency and phase.**

Fail Safe Operation

In the event of power failure, or the actuation of a remote bypass switch, a relay switch routes the program signal around the instrument, by-passing all circuitry and thus providing fail-safe operation.

Safety Considerations

The instrument is intended to be operated from a single-phase power source which has one of its current-carrying conductors (neutral) at or near ground (earth) potential. Operation from other power sources where both current-carrying conductors are live with respect to ground (such as phase-to-phase on a multi-phase system) is not recommended, as only the Line Conductor has over-current (fuse) protection within the instrument.

ELECTRICAL CHARACTERISTICS

Performance Conditions

Characteristics and their Performance Requirements described in this section are valid over the stated environmental range, for instruments calibrated at an ambient temperature between +20°C and +30°C. Instrument warm-up of five (5) minutes is required.

TABLE 1-1

PROGRAM CONTROL SYSTEM

Characteristic	Performance Requirement	Supplemental Information
Signal Input Level		
UNITY GAIN	Within 0.5% of Unity Gain	
VAR	1 V P-P within 30%	
Input Impedance	75 Ω nominal	
Input Return Loss		
POWER ON	At least 46 dB to 5 MHz	
POWER OFF or BYPASS	At least 40 dB to 5 MHz	
Output Impedance (all)	75 Ω nominal	
Output Return Loss (all)	At least 30 dB to 5 MHz	
Video Delay	48°, ±5° at subcarrier frequency	
Output Blanking DC Level (all)	50 mV or less	
Isolation		
PROGRAM & PREVIEW OUT		At least 46 dB to 5 MHz
PROGRAM & PROGRAM MONITOR OUT		At least 34 dB to 5 MHz
Inserted Signal Level	Within 1% of nominal	
Amplitude Ratio		
2T Pulse to Bar	100% within 0.5%	
Mod Sin^2 Pulse	100% within 1%	Chrominance to Luminance
Waveform Tilt		
Field Rate Square Wave	0.5% or less	
25 μs Bar	0.5% or less	
Differential Phase (10-90 APL, Standard Input)		
Program Output	0.15° or less	
Preview Output	0.3° or less	
Differential Gain (10-90 APL, Standard Input)		
Program Output	0.2% or less	
Preview Output	0.4% or less	

TABLE 1-1 (cont)

Characteristic	Performance Requirement	Supplemental Information
Line Time Amplitude Non-Linearity	0.5% or less	
Random Noise Output		
Program Output	At least 75 dB (RMS) down	
Residual Subcarrier On Non-Inserted Lines	At least 60 dB down	
Hum or Transients On Non-Inserted Lines	At least 60 dB down when viewed on 529 monitor.	
Spurious Signals During Blanking Lines	At least 40 dB down when viewed on 529 monitor.	
Signal Attenuation in "Delete" Mode		
2T Pulse	At least 70 dB	
Subcarrier (color bars)	At least 60 dB	
Crosstalk Into Program Channel From Internal Signal		
2T Pulse	At least 70 dB down	
Subcarrier (staircase)	At least 60 dB down	
INSERT DELAY—Inserted Signal Blanking Leading Edge Relative to Leading Edge of Sync		Adjusted at Factory for 1.6 μs front porch.
Adjustment Range of Inserted Signal Blanking for use with External Sync		At least ±3 μs
INSERT DELAY Range	At least + and − 0.5 μs (1 μs total)	
Time Jitter		5 ns or less
Unwanted Pedestal at time of VITS insertion	0.7 IRE or less	

TABLE 1-2

TEST SIGNAL ELEMENTS
(VIT or FULL FIELD)

Characteristic	Performance Requirement	Supplemental Information
MULTIBURST Signal		
White Ref Amplitude	100 IRE within 1 IRE	
Burst Amplitude		
Normal Level	90 IRE (P-P) within 1 IRE	
Reduced Level	60 IRE (P-P) within 1 IRE	
Average Level		
Normal	55 IRE within 1 IRE	
Reduced	40 IRE within 1 IRE	
Burst Frequencies	0.5 MHz within 3%	
	1.5 MHz within 3%	Adjustable range to 1.25 MHz
	2.0 MHz within 3%	
	3.0 MHz within 3%	
	3.58 MHz within 3%	
	4.2 MHz within 2%.	Adjustable range to 4.1 MHz.
Burst Harmonic Content	−40 dB	
Burst Timing	Each burst starts at 0° and consists of a whole number of cycles	
LINEARITY Signal		
Staircase Signal		
Luminance		
Amplitude		
10 Step	90 IRE within 1 IRE	Adjustable between 80 and 100 IRE
5 Step	90 IRE (within 1 IRE)	Adjustable between 80 and 100 IRE
Riser		
5 and 10	Amplitude of each riser is within 1%	
Risetime (All Identical)	≈230 ns	
Chrominance		
Frequency		
Free Run	3.579545 MHz within 25 Hz	
Locked Mode	Locked to incoming burst	

TABLE 1-2 (cont)

Characteristic	Performance Requirement	Supplemental Information
Chrominance (cont)		
Amplitude	40 IRE	Within 0.5 IRE
Inherent Differential Gain	0.5% or less	
Inherent Differential Phase	0.2° or less	
Envelope Rise and Fall Times	≈375 ns	
Residual Subcarrier On Insertion Lines		0.5 IRE or less
Timing	Waveform transitions determined by characteristic instants (See Fig. 1-2)	
Ramp Signal		
Amplitude	100 IRE (Adjustable to 80 IRE)	Within 1 IRE
Linearity	Within 1%	
Timing	(See Fig. 1-2)	
SIN^2 PULSE; 2T or T, and Integrated Sin^2 Pulse (Bar) 2T or T Signal		2T pulse, T Bar Factory programmed
2T Pulse		
Pulse to Bar Ratio	0.99 to 1.01	
Half Amplitude Duration	250 ns	Determined by 9 Pole Kastelein[4] Filter
Ringing Amplitude	0.5 IRE or less	
Ringing Duration		4 cycles or less (determined)
Timing	(See Fig. 1-2)	
2T Bar		
Risetime	250 ns	
Amplitude	100 IRE	
Timing	(See Fig. 1-2)	
T Pulse	0.125 μs HAD	Determined by 9 Pole Kastelein Filter
T Bar		
Amplitude	100 IRE within 1 IRE	
Risetime	115 ns	Within 15%
Duration and Timing	(See Fig. 1-2)	

[4] A. Kastelein, "A NEW SINE-SQUARED PULSE AND BAR-SHAPING NETWORK", IEEE Transactions of Broadcasting, Volume BC-16, Number 4, DEC. 1970 (pp 84–89).

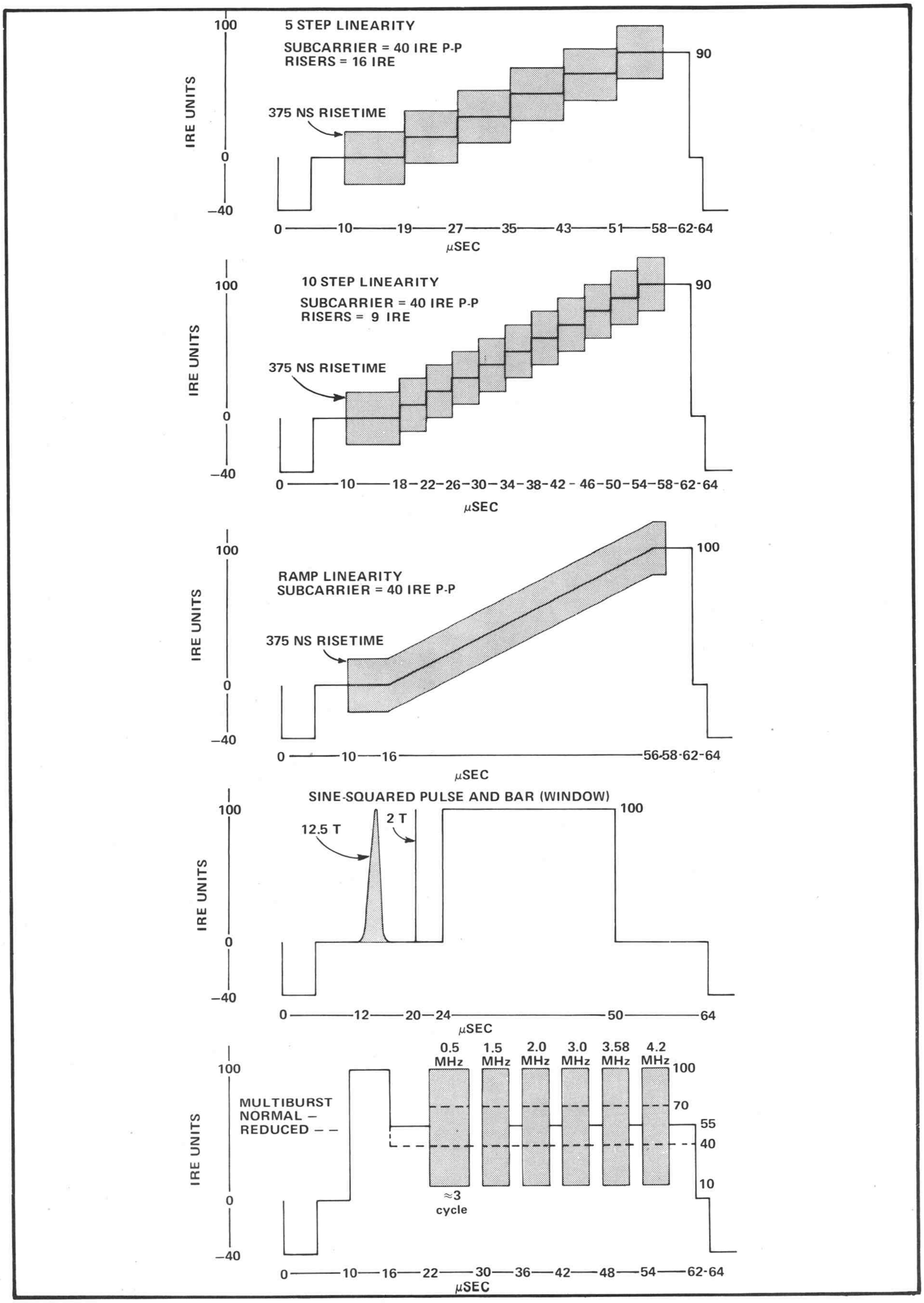


Fig. 1-2. Test signal output timing details.

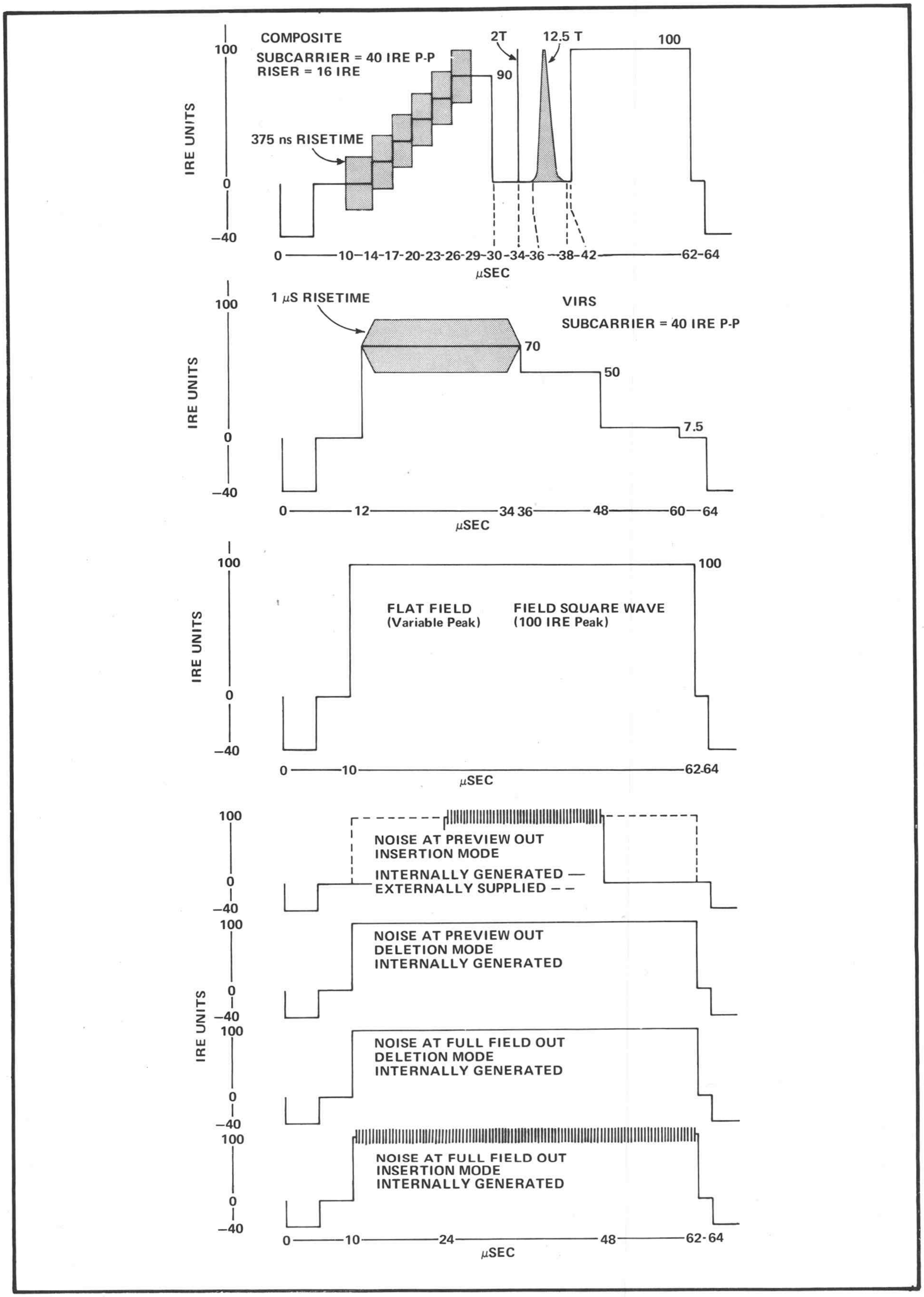


Fig. 1-2. Test signal output timing details. (cont)

TABLE 1-2 (cont)

Characteristic	Performance Requirement	Supplemental Information
MODULATED SIN^2 PULSE	12.5T or 20 T	20T pulse also available by internal jumper connection. Factory connected for 12.5T
Amplitude of Luminance Component	50 IRE	
Amplitude Difference of Peak Chrominance to Peak Luminance	0.5 IRE or less	
Chrominance-Luminance Delay	±10 ns or less	
HAD (Half Amplitude Duration) of 12.5T	1.57 μs	Within 0.075 μs
HAD (Half Amplitude Duration) of 20T	2.5 μs	Within 0.1 μs
Residual Subcarrier on Insertion Line	0.5 IRE or less	
Harmonic Content of Subcarrier	−40 dB	
Phase		
VIT Range	0° to 360°	May be used for identification purposes
FULL FIELD	Phase modulated at field rate	
WINDOW Signal		
Amplitude	Same as Bar	
Risetime	Same as Bar	
Duration	26 μs/line X 152 lines	Lines 66 through 218
COMPOSITE Signal		
Linearity Test Signal	Same as full line 5 steps staircase except for duration (see Fig. 1-2)	
Sin^2 Pulse	Same as Full Line signal	
Modulated Sin^2 Pulse	Same as Full Line signal	
Sin^2 Bar	Same as Full Line signal	
FLAT FIELD Signal		
BOUNCE (10-90 APL)	Automatic bounce between 10 and 90 IRE	Within 2 IRE
RATE	≈1 second to greater than 10 seconds	

TABLE 1-2 (cont)

Characteristic	Performance Requirement	Supplemental Information
FLAT FIELD Signal (cont)		
VARIABLE	11 levels, equal within 2%	
Risetime	≈230 ns	
Time Location		Active portion of Line (See Fig. 1-2)
FIELD SQ WAVE Signal		
Amplitude Relative to White Reference	100 IRE within 2 IRE	
Lines White	Lines 57 through 227 (each field)	
Lines at Blanking	All other active lines	
Risetime	230 ns	
NOISE		
Noise Measurement Signals		
Pedestal Amplitude		
10 IRE	10 IRE, nominal	Within 2%
50 IRE	50 IRE, nominal	Within 2%
100 IRE	100 IRE, nominal	Within 2%
Variable Pedestal Range (Insertion Mode Only)	±10 IRE, nominal	
Noise Amplitude	−20 dB to −59 dB (0 dB = 700 mV RMS)	
Noise Attenuators		
Absolute Amplitude	Within 1 dB	
Noise Spectrum		
FLAT Energy/Unit Bandwidth	15 kHz to 5 MHz, flat within 6 dB	
Output Impedance	75 Ω (nominal)	
Output Return Loss	At least 30 dB	

TABLE 1-3

VERTICAL INTERVAL REFERENCE SIGNAL

Characteristic	Performance Requirement	Supplemental Information
Vertical Interval Reference Signal (VIRS)		
Chrominance Reference		
Amplitude	40 IRE	Within 0.4 IRE
Phase	180°	Adjusted with front-panel INSERT SUB-CARRIER PHASE control.
Timing	See Fig. 1 2	
Envelope Risetime	1 μs	Within 15%
Average Level of Chrominance Signal	70 IRE	Within 0.7 IRE
Luminance Reference		
50 IRE Level	50 IRE within 0.5 IRE	
Black Reference	7.5 IRE within 0.5 IRE	

TABLE 1-4

FULL FIELD OUTPUT

Characteristic	Performance Requirement	Supplemental Information
Full Field Test Signal Outputs		
Amplitude Relative to Inserted Signals of Same Type	Within 1% (both outputs)	
Return Loss	At least 30 dB	
Full Field Noise Measurement Signal	Same as Noise Measurement (see TEST SIGNAL ELEMENTS) except when NOISE switch is in INSERTION position; Noise and Pedestal are full duration instead of 1/2 Line.	
Sync and Burst Timing	See Fig. 1-3 and 1-4.	

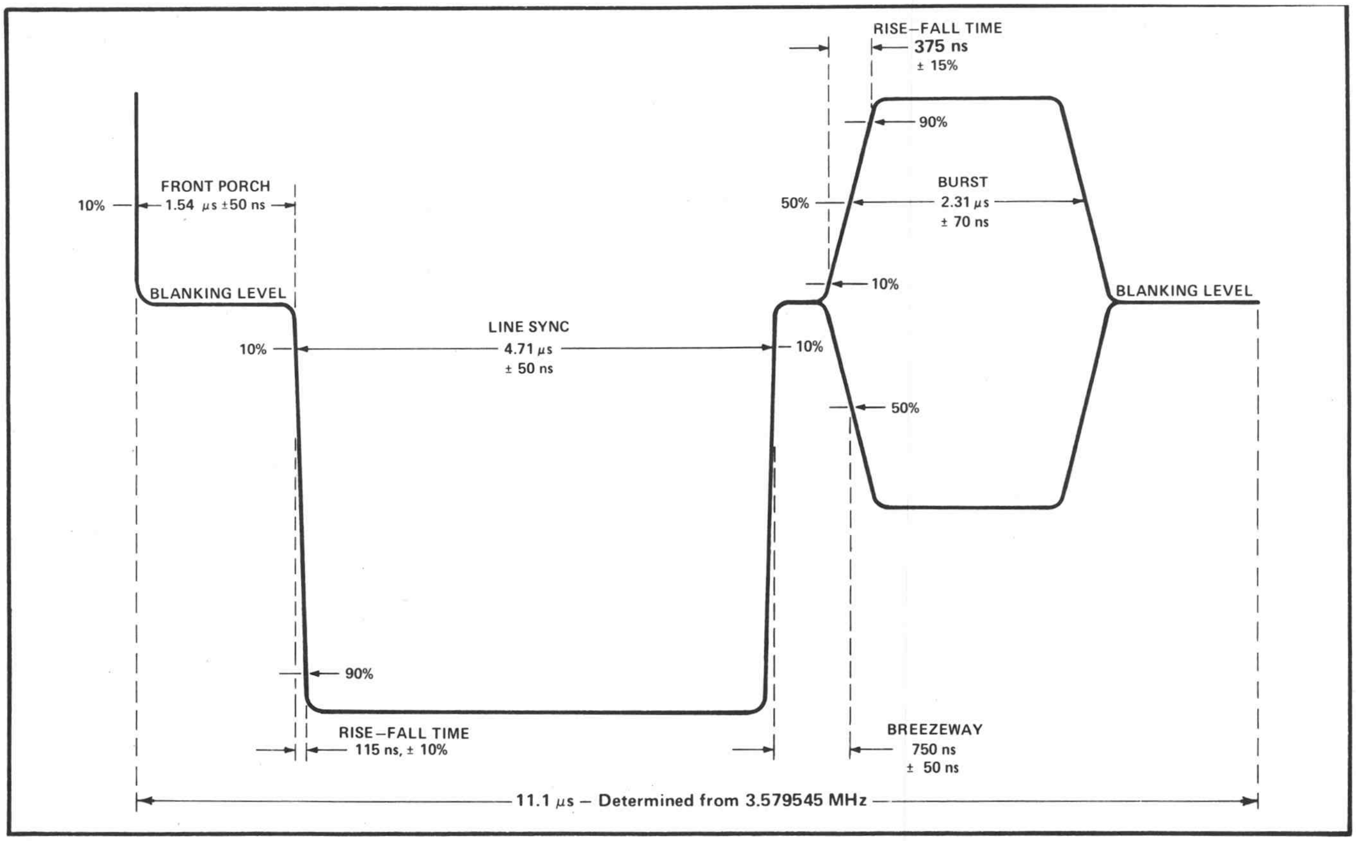


Fig. 1-3. Horizontal blanking details.

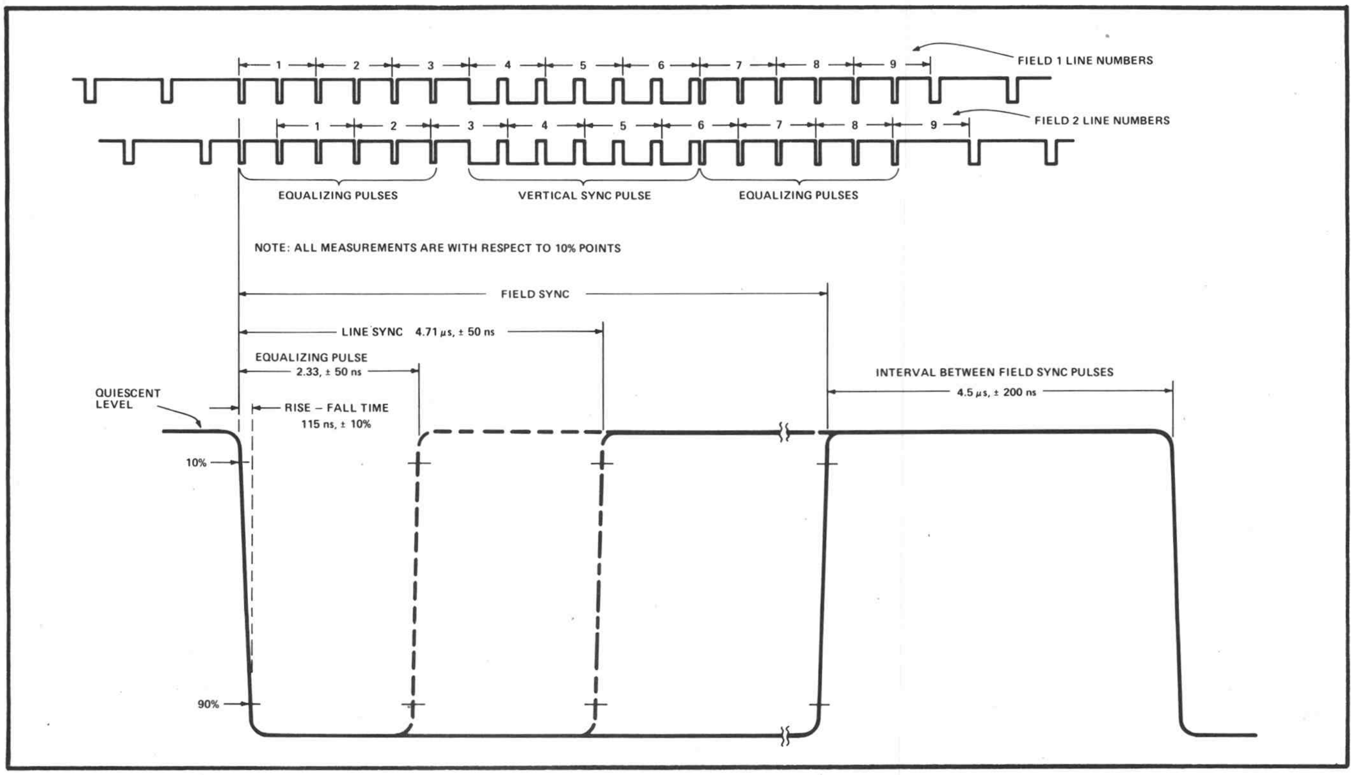


Fig. 1-4. Comp Sync blanking details.

TABLE 1-5

POWER SUPPLY

Characteristic			Performance Requirements	Supplemental Information
Line Voltage Range				
	115 VAC	Low		90 V to 110 V
		Medium	104 V to 126 V	
		High		112 V to 136 V
	230 VAC	Low		180 V to 220 V
		Medium		208 V to 252 V
		High		224 V to 272 V
	Crest Factor			At least 1.35
Maximum Line Current			0.5 A	
Maximum Power Consumption			40 W	
Line Frequency Range			48 to 66 Hz	

TABLE 1-6

PHYSICAL

Characteristic	Information	
Finish	Cabinet is blue-vinyl painted. Front panel is anodized aluminum.	
Dimensions	**Rackmount**	**Bench Model**
Overall		
Height	3.47 inches	3.82 inches
Width	19.0 inches	18.225 inches
Length	19.66 inches	19.1 inches
Cabinet		
Height		3.47 inches
Width	16.88 inches	17.1 inches
Length	18.41 inches	18.41 inches
Width Over Sides	17.625 inches	
Length with BNC-T	18.6 inches[5]	18.91 inches[6]

[5] **18.67 inches with BNC Cable to Connector.**

[6] **18.98 inches with BNC Cable to Connector.**

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ENVIRONMENTAL CHARACTERISTICS

The following environmental test limits apply when tested in accordance with the recommended test procedure. This instrument will meet the electrical performance requirements given in this section following an environmental test. Complete details on environmental test procedures, including failure criteria, etc., may be obtained from Tektronix, Inc. Contact your local Tektronix Field Office or representative.

ACCESSORIES

Standard accessories supplied with this instrument are listed in the Mechanical Parts List.

TABLE 1-7

ENVIRONMENTAL

Characteristic	Information
Temperature	
Non-Operating Range	−40°C to +65°C
Operating Range	0°C to +50°C
Altitude	
Non-Operating Range	To 50,000 feet
Operating Range	To 15,000 feet

NOTES

SECTION 2
OPERATING INSTRUCTIONS

General

This section of the manual is intended to provide the operator with information necessary for proper operation of the 147. Included are (1) Initial Installation information dealing with the various line voltages that may be used to power the instrument, and information regarding Local or Remote operation; (2) Controls and Connectors, a brief discussion of each control and connector; (3) Basic Information, dealing with the different signals generated by the 147 and how they might be used; (4) First Time Operation, a complete step-by-step procedure using each control and connector; (5) Operating Changes, dealing with all internal changes that can be made for different applications; and (6) Option 01, dealing with Remote Control Monitoring; and (7) Glossary of Terms.

It is recommended that the user of this instrument refer to the following reference material as a supplementary source of information.

Television Systems Measurements, MEASUREMENTS CONCEPT BOOK, First Edition (March, 1969), Tektronix, Inc.

Television Signal Analysis, Second Edition (April, 1963) American Telephone and Telegraph Company Long Lines Department (Revised By Network Transmission Committee of the Video Transmission Engineering Advisory Committee).

INSTALLATION

Operating Voltage

The 147 may be operated from either 115-VAC or 230-VAC (nominal) line voltage source. Quick-change line-voltage plugs, located under the fuse cover on the rear panel, change the transformer primary connections so the instrument will operate from one line voltage or the other (115 V or 230 V). In addition, the plugs permit one of three line voltage operating ranges to be selected. Table 2-1 lists the voltage ranges that enable the instrument DC power supplies to regulate properly.

To convert to a different line voltage, proceed as follows:

1. Disconnect the 147 from the power source.

TABLE 2-1

115/230 Voltage Selector Plug Position	Range Selector Plug Position	Nominal Line (Center) Voltage	Line Voltage Plug Range [1]
115 V	LO (Low)	100 VAC	90 to 110 VAC
	M (Medium)	115VAC	104 to 126 VAC
	HI (High)	124 VAC	112 to 136 VAC
230 V	LO (Low)	200 VAC	180 to 220 VAC
	M (Medium)	230 VAC	208 to 252 VAC
	HI (High)	248 VAC	224 to 272 VAC

[1] Applicable when the line contains less than 2% total distortion.

2. Unscrew the two captive screws holding the fuse cover. Remove the cover and attached fuses.

3. Pull out the 115/230 Voltage Selector plug (see Fig. 2-1), then rotate the plug 180° and insert it into the opposite set of holes. The 115/230 Voltage Selector plug is located in the upper position for 115-V operation, and in the lower position for 230-V operation.

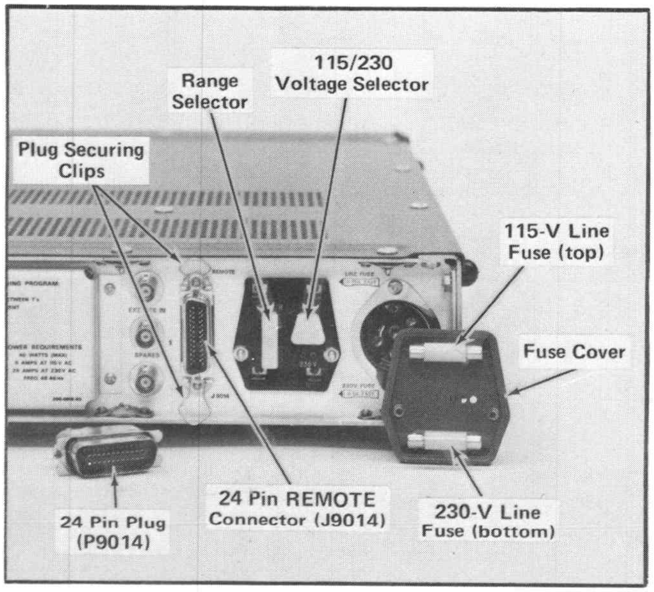


Fig. 2-1. Location of Range and Voltage Selector plugs with fuse cover removed (plugs as shown are set for 115-V medium range operation). Also shown is the REMOTE (J9014) connector, Plug (J9014), and plug securing clips.

4. To change the line-voltage operating range (LO, M, or HI), pull out the Range Selector plug (see Fig. 2-1) and insert it in the desired hole locations. Select a range with a center voltage (see column three in Table 2-1) closely corresponding to the line voltage that will be applied in regular instrument operation.

5. Re-install the cover with two captive screws and fuses. Be sure the cover fits firmly against the rear panel. This indicates that the line fuses are seated properly in the fuse clips.

6. Before applying power to the instrument, check that the indicating tabs on the selector plugs protrude through the proper holes in the cover for the correct line voltage and the proper operating range.

CAUTION

The 147 should not be operated with the 115/230 Voltage Selector and/or Range Selector plugs in the wrong position for the line voltage applied.

Local-Remote Connector

The 147 may be operated by local or remote means. (Local refers to 147 operation from the front-panel.) A 24 pin connector (REMOTE J9014) see Fig. 2-1, is incorporated on the rear-panel. Installed to this is a REMOTE plug (P9014, Tektronix Part No. 131-0325-00). This plug is factory wired for LOCAL operation, see Fig. 2-2.

To operate Remote, separate switching must be used at the remote location(s). In addition, the 24 pin plug must be wired accordingly. Fig. 2-3 shows the external switching

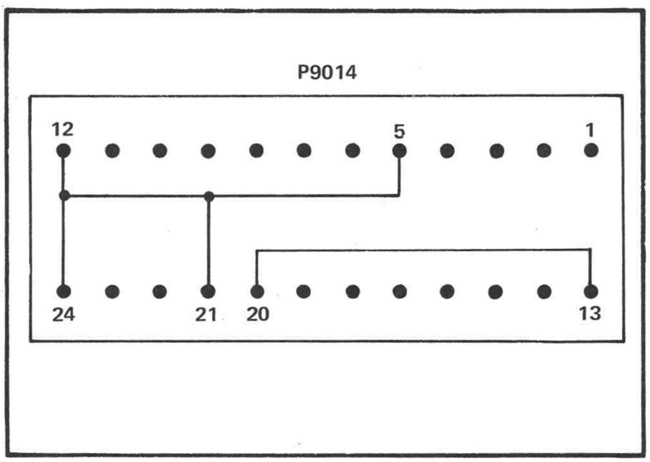


Fig. 2-2. Wiring diagram of Remote Plug for LOCAL operation (factory connected).

required for remote control of FULL FIELD, VIRS, PROGRAM, or VITS. The external switching may be separate or combined to be controlled by one operator. Once the necessary wiring is complete, reconnect the plug to the REMOTE connector (J9014) and lock into place with the two securing clips shown in Fig. 2-1.

Pin 6 of the REMOTE connector can be used (not dependent upon Local or Remote operation) as an Input or Output as follows:

OUTPUT—With no burst to the 147 PROGRAM LINE IN or BLACK BURST IN, Pin 6 will be 0 volts.

With burst to the 147 PROGRAM LINE IN or BLACK BURST IN, Pin 6 will be +5 volts.

INPUT—With Pin 6 grounded (⏚), subcarrier will be available at the rear-panel CW SUBCARRIER OUTPUT at all times.

With Pin 6 open (not connected), subcarrier will not be available at the rear-panel CW SUBCARRIER OUTPUT with loss of incoming burst at either the PROGRAM LINE IN or BLACK BURST IN.

CONTROLS AND CONNECTORS

Introduction

The following describes the function or operation of the 147 controls and connectors. Refer to Fig. 2-4 for locations of the controls and connectors.

Front-Panel Controls

POWER	Toggle switch to turn instrument power ON and OFF. Lamp indicates when POWER switch is ON and the instrument is connected to a line voltage source.
NONSYNCHRONOUS MODE—NO VITS	Lamp indicates absence of incoming synchronizing information (e.g., no externally applied composite video or black burst). In this state, no VITS will be added. Full Field signals are generated, but subcarrier free runs at approximately 3.58 MHz; line and field sync are mutually coherent, but not with subcarrier.
PROGRAM CONTROL	Consists of three lever switches, four variable controls, and two indicator lamps to (1) set the level of program and auxiliary pedestals, (2) select control of signal modes, and (3) indicate operating status.

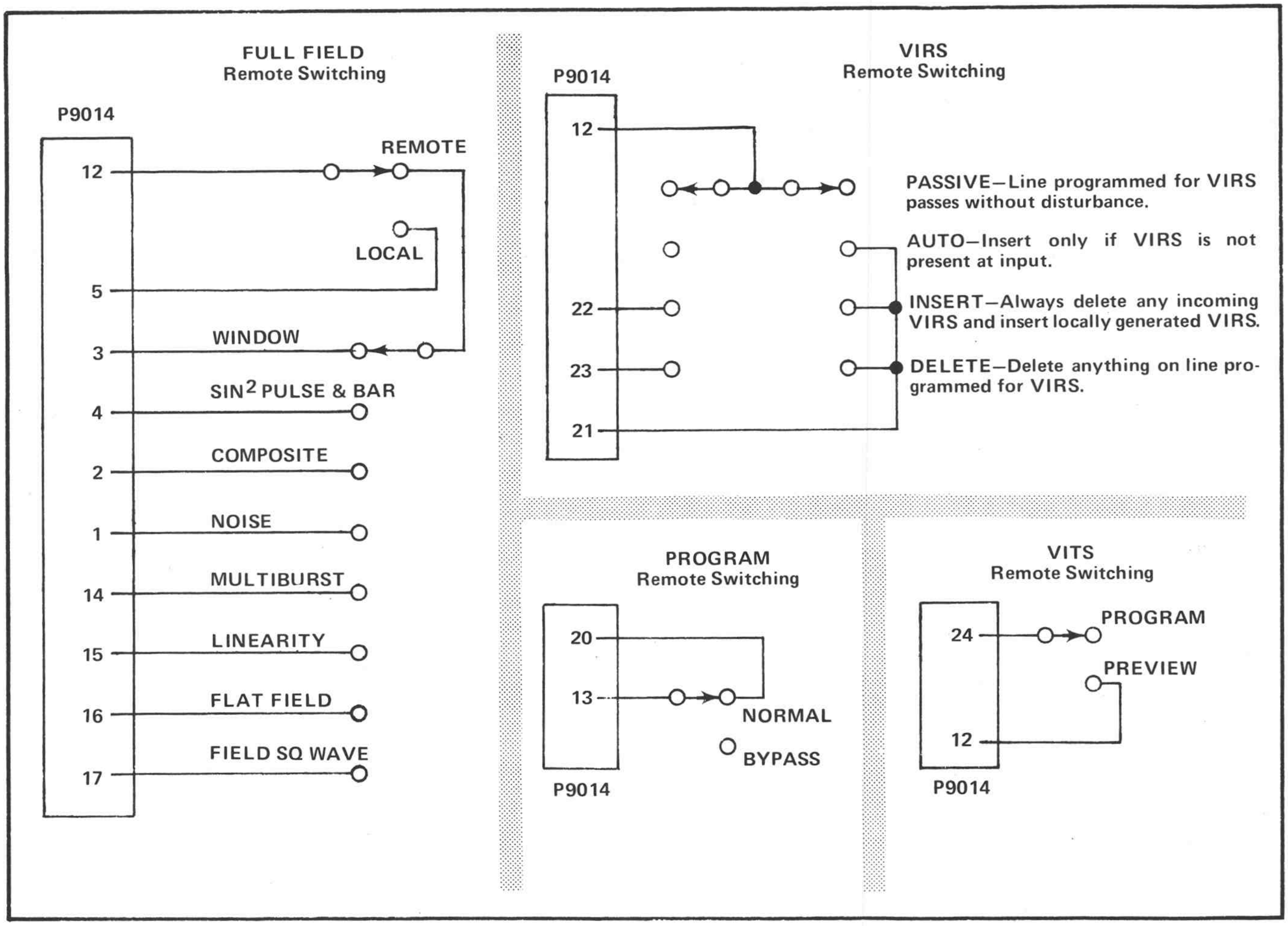


Fig. 2-3. Wiring diagrams for REMOTE operation of the 147.

UNITY GAIN/VAR — Two position lever switch to select unity gain between PROGRAM INPUT and PROGRAM OUTPUT or control of gain by adjustment of LEVEL control.

LEVEL — Control to adjust gain between PROGRAM INPUT and PROGRAM OUTPUT when UNITY GAIN/VAR switch is in VAR position.

INSERT DELAY — Control allows adjustment to control time positioning of internally generated VITS with respect to the incoming signal.

INSERT SUB-CARRIER PHASE — Front-panel screwdriver adjustment to control phase of the color subcarrier on internally generated signals to match the phase of the incoming burst signal.

LOCAL/REMOTE — Two position lever switch to select control of PROGRAM or PREVIEW modes from the front-panel (Local) or from a remote location. Remote operation is controllable by connection of a remote switching circuit to the rear panel. This switch controls only this function of the remote.

PROGRAM/PREVIEW/AUXILIARY — Three position lever switch to select one of the following modes:

PROGRAM — VITS are inserted on the PROGRAM LINE, PROGRAM MONITOR, and PREVIEW MONITOR OUTPUTS according to internal selection of test signals and their time address.

PREVIEW — VITS are inserted on PREVIEW MONITOR OUTPUT only. With

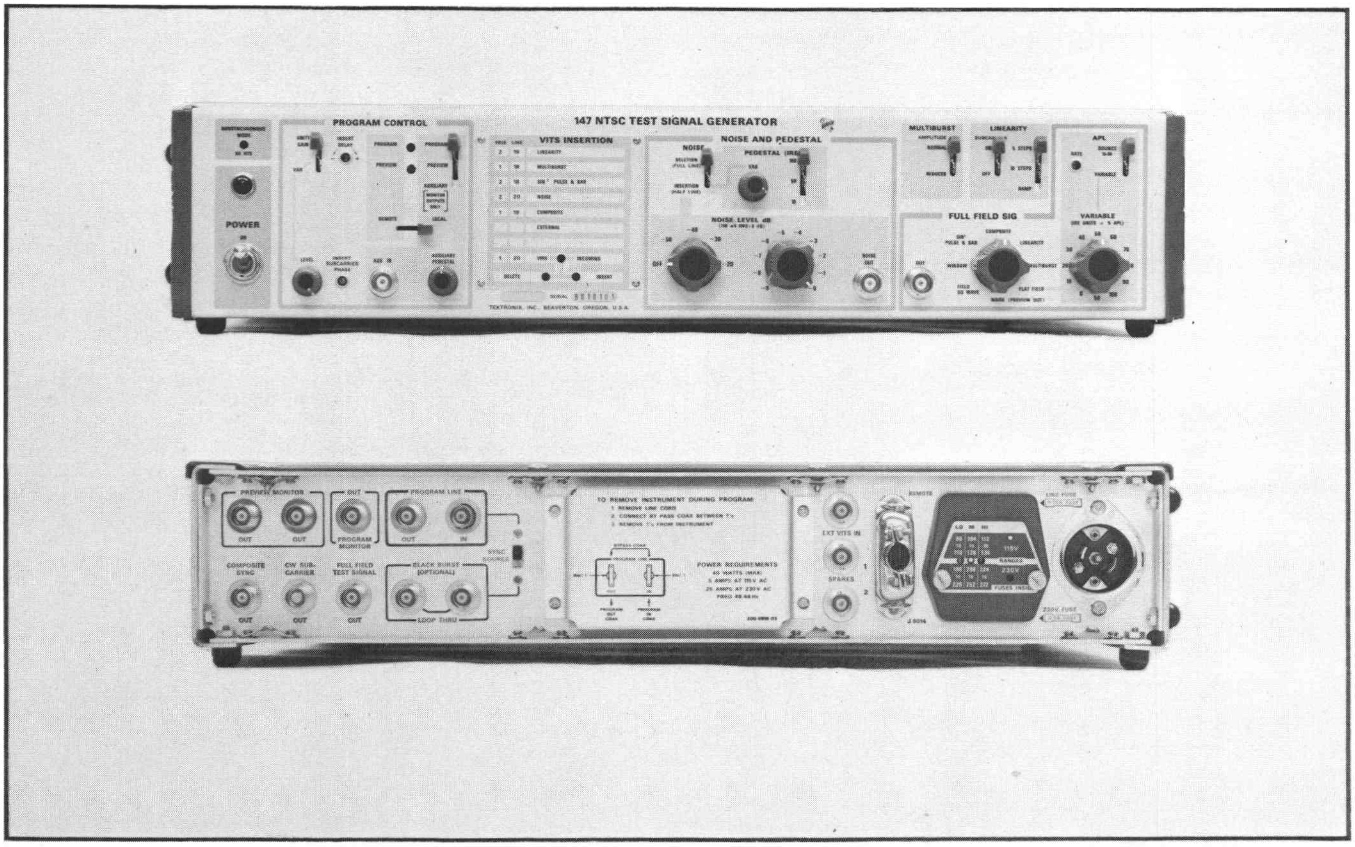


Fig. 2-4. 147 front- and rear-panel controls and connectors.

FULL FIELD SIG mode switch set to NOISE, the noise signal will be inserted during active line time for Full Field Noise Measurements (will not be present in PROGRAM mode).

AUXILIARY — Permits the use of non-video signals at the AUXILIARY INPUT (such as a sweep generator or non-composite video signal). This signal appears at the PROGRAM MONITOR and PREVIEW MONITOR OUTPUTS with composite blanking and sync added, operates as a sync and blanking adder. This mode is not available in REMOTE (the program signal is bypassed through the relay).

AUXILIARY PEDESTAL — Control provides a DC offset so that auxiliary signal excursions may be positioned between the black and white levels of the resulting composite video signal.

PROGRAM/PREVIEW Lamps — Lamps to indicate status. Required since the PROGRAM/PREVIEW/AUXILIARY switch may not indicate actual operating mode when in REMOTE. Both lamps out indicates relay is not energized.

VITS INSERTION — Consists of a front-panel array of write-in spaces where the internal line and field addresses of the VIT signals may be indicated, and three lamps to indicate status of a VIRS. (A cover plate for this area designates the time address for the several signals as shipped from the factory, which can be replaced with the accessory cover plate if desired.)

VIRS INCOMING — Lamp indicates the presence of a VIRS on the incoming composite video signal (Green).

VIRS DELETE — Lamp indicates that any signal on line programmed for VIRS is being deleted (Red).

VIRS INSERT — Lamp indicates that internally generated VIRS is being inserted on line programmed for VIRS (Yellow).

NOTE

Control of VIRS DELETE and VIRS INSERT function is by remote selection. Selection includes:

PASSIVE--Line programmed for VIRS passes without disturbance.

INSERT--Always delete any incoming VIRS and insert locally generated VIRS.

AUTO--Insert only if VIRS is not present at input.

DELETE--Delete anything on line programmed for VIRS.

NOISE AND PEDESTAL — Consists of two lever switches, two rotary switches, and one variable control to select conditions of the NOISE signal.

NOISE — Two position lever switch to select mode.

DELETION/INSERTION — (Refers to VIT and Full Field on PREVIEW MONITOR OUTPUT)

Two position lever switch to select mode.

DELETION — In this position, noise is eliminated and pedestal added on the full line.

INSERTION — In this position, any noise present during the center half of a line is removed and the internally generated noise and pedestal is inserted. (FULL FIELD SIG OUT has full line of noise and pedestal.)

PEDESTAL (IRE) — Switch selects one of three indicated (10, 50, or 100) IRE levels of pedestal on which noise measurements can be made.

VAR — Control permits variation of at least ± 10 IRE in the pedestal amplitude in the INSERTION position of the NOISE INSERTION/DELECTION switch. Permits accurate matching of pedestal level on which noise measurement is made.

NOISE LEVEL dB — Two rotary switches control the amplitude of the internally generated noise signal.

FULL FIELD SIG — Consists of two rotary and one lever switches to select the type of test signal available at the OUT (or rear-panel FULL FIELD TEST SIGNAL) connector and to select the type of control over the FLAT FIELD signal.

FULL FIELD Mode — Eight position rotary switch to select one of the following signals to appear at the OUT connector: MULTIBURST, LINEARITY, FLAT FIELD, FIELD SQ WAVE, WINDOW, SIN^2 PULSE AND BAR, COMPOSITE, or NOISE.

APL — Two position lever switch to control APL of FLAT FIELD signal.

BOUNCE 10-90 — In this position, the active portion of the line automatically bounces between 10 IRE and 90 IRE at a repetition rate determined by the RATE control.

RATE — Front-panel screwdriver control to set repetition rate of bounce from 1 to 15 seconds.

VARIABLE — In this position, the level of the active portion of the line is selectable as determined by the VARIABLE switch.

VARIABLE — 12 position rotary switch used to select the level of the active portion of the line in 10 IRE steps from 0 to 100 IRE.

MULTIBURST AMPLITUDE — Two position lever switch to select peak to peak amplitude of MULTIBURST signal.

NORMAL — In this position, the peak to peak amplitude of multiburst will be 90 IRE centered about the 55 IRE level.

REDUCED — In this position, the peak to peak amplitude of multiburst will be 60 IRE centered about the 40 IRE level.

LINEARITY — Consists of two lever switches to control the LINEARITY test signal.

SUBCARRIER

ON	Subcarrier is added to 5 step, 10 step, or Ramp signal. (Subcarrier is in phase with incoming color burst.)
OFF	Subcarrier is removed from LINEARITY and COMPOSITE STAIRCASE signals.
5 STEP/ 10 STEP/RAMP	Three position lever switch to select type of LINEARITY test signal.
5 STEP	LINEARITY signal consists of the 5 step staircase.
10 STEP	LINEARITY signal consists of the 10 step staircase.
RAMP	LINEARITY signal consists of the Ramp.

Rear-Panel Control

SYNC SOURCE	Two position lever switch to select either the PROGRAM LINE IN or BLACK BURST IN (composite sync with burst) signal as sync source.
Input Connectors	All input signals (except remote plug) are via BNC type connectors.
AUX IN (1 front panel)	75 Ω input for non-video type signals.
BLACK BURST (2 rear panel)	High impedance loop-thru connection compensated for 75 Ω.
EXT VITS IN (1 rear panel)	75 Ω input, added to composite video, output to deleter and inserter circuit. Must not have VITS on the lines programmed for other 147 VITS. (Must not have sync and burst if not disconnected when AUXILIARY is used.)
Output Connectors	All output connectors are BNC type with 75 Ω impedance.
PROGRAM LINE OUT (1 rear-panel)	Program output signal, with VITS added or not, according to PROGRAM CONTROL. Connected to PROGRAM LINE IN through relay in bypass or POWER OFF modes.
PROGRAM MONITOR (1 rear-panel)	Same as PROGRAM LINE OUT except when relay is in Bypass mode. May have auxiliary added.
PREVIEW MONITOR (2 rear-panel)	Always has VITS added and may have AUXILIARY or NOISE added.
FULL FIELD TEST SIGNAL (1 front and 1 rear-panel)	Full field test signal.
NOISE OUT (1 front-panel)	Noise test signal (no sync or blanking).
CW SUB-CARRIER (1 rear-panel)	Regenerated subcarrier signal, 2 volts peak to peak.
COMPOSITE SYNC (1 rear-panel)	Reprocessed sync signal, 4 volts peak to peak.

GENERAL INFORMATION

Television signals are complex waveforms. For this reason many test units are required to check one characteristic or another of the video system.

The 147 is one such test unit; but it differs from others, in that it will provide complete time domain testing of a video system. All signals generated are controlled by a digital programmer which is Gen-Locked (normally), but may operate from its own oscillator. The following signals are generated by the 147:

MULTIBURST--Generated by a function generator and controlled by a digital programmer, this signal consists of a white flag (100 IRE) and six discrete packets of burst frequencies from 0.5 to 4.2 MHz. Each burst packet may be set for an exact number of cycles, regardless of the frequency. Multiburst is generally used for quick gain vs. frequency verification.

LINEARITY--Staircase, either 5 or 10 step, or ramp is available. Subcarrier (phase locked to burst--180°) modulates either the staircase or ramp, and may be turned off by a front-panel control. Measurement of Differential Gain and Differential Phase may be made using the LINEARITY signal.

SIN^2 PULSE AND BAR--Sin^2 Pulse and Bar waveforms (2T and T) are generated to 9 pole Kastelein Filters[2]. The dig-

[2] **A. Kastelein, "A NEW SINE-SQUARED PULSE AND BAR SHAPING NETWORK", IEEE Transactions of Broadcasting, Volume BC-16, Number 4, DEC. 1970 (pp 84-89).**

ital programmer provides the high degree of timing accuracy required in these pulses to eliminate jitter. The programmer also exactly determines pulse to pulse spacing and bar width. However, the programmer may be reprogrammed, to produce different spacing or bar widths in 2 μs increments should the need arise. Application includes K Factor measurements for short time distortions.

The 12.5T Modulated Sin^2 Pulse has a 1.57 μs HAD, with the envelope of the Modulated Sin^2 Pulse formed in the function generator rather than in a filter. This allows programming for any desired pulse width from 1.5 μs to 2.5 μs. This signal is generally used to measure relative gain and delay errors between chrominance and luminance.

WINDOW--This signal is the standard Window signal now being used within the industry, with the exception that the Modulated Sin^2 Pulse and Bar has been added. Generally used with a picture monitor to observe streaking, etc., it is also used to check for both line and field time distortions.

FIELD SQ WAVE--This signal, similar to the WINDOW signal, has lines 66 through 218 of each field at 100 IRE, thereby simulating a 60 Hz square wave, capable of passing through clamper amplifiers. It is used for accurate measuring of field time distortions.

FLAT FIELD--This composite video signal has, during the active portion of each field, a luminance level variable from 0 to 100 IRE in 10 IRE increments, or which bounces automatically between 10 and 100 IRE at a repetition rate of 1 to 15 seconds. It is used to test clamper amplifiers and systems in general, for APL dependent distortions.

NOISE--The calibrated noise generator provides white noise (flat) at 10, 50, or 100 IRE luminance levels. This offers a unique signal to noise measuring technique, which may be performed during the vertical interval or on an out of service basis as a Full Field signal on the PREVIEW MONITOR OUTPUTS in the PREVIEW mode of operation.

COMPOSITE--This signal is composed of the LINEARITY 5 Step staircase and SIN^2 PULSE AND BAR signals described above. Only the horizontal timing has been changed to incorporate both signals within the time of one line.

VIRS--The proposed VIRS can be generated by the 147, and it may be inserted on line 20 of either or both fields as programmed. Standard operational practices regarding VIRS have not been worked out. Therefore, the 147 has been designed to be programmable for a number of possible operating modes. Indicator lamps indicate the presence of an incoming VIRS, whether the incoming VIRS is being deleted and whether a local VIRS is being inserted.

NOTE

VIRS will not be inserted on monochrome video.

Vertical Interval Insertion/Deletion

When the digital programmer is Gen-Locked to a program signal, it may delete and re-insert local VITS as determined by the programming.

As the VITS Deleter/Inserter function involves active circuit elements in the programming within the 147, fail-safe means are provided in the event of a malfunction within the instrument such as loss of sync, power, etc.

A PREVIEW function allows the observation of exactly what lines will be deleted and exactly what signals and levels will be inserted on the program line signal before they are inserted on the program signal itself.

Changes in the programming of the several VIT signals are readily done by removing or moving coded jumpers within the 147. Any signal may be eliminated or moved.

FIRST TIME OPERATION

General

The following is primarily intended to familarize operating personnel with the operation of the 147. It consists of a step-by-step procedure which, makes use of each front- and rear-panel control and connector. This procedure will, in most cases, simulate the actual in-service operation of the 147.

The procedure makes use of a waveform monitor to observe field and line rate displays and a vectorscope to observe phase characteristics. An external video source is needed to provide program material (composite video) and an external VIT. The following equipment is used: Tektronix Type 140 NTSC Test Signal Generator, used as an external video and VIT source; Tektronix Type 529 Waveform Monitor, used to observe field and line rate displays; Tektronix Type 520 NTSC Vectorscope, used to observe phase characteristics. Proper operation of each unit is assumed; refer to the individual operating instructions for each.

The procedure requires the use of seven (7), 75 Ω BNC coaxial cables (Tektronix Part No. 012-0074-00), four (4) 75 Ω end-line terminations (Tektronix Part No. 011-0102-00), and one (1) 75 Ω feed-thru termination (Tektronix Part No. 011-0103-02, supplied with 147). A small blade screwdriver (XceLite R3323 or equivalent) is also required.

Unless stated otherwise, all 147 front- and rear-panel controls and connectors referred to will be in upper-case letters (e.g., LINEARITY SUBCARRIER) and all controls and connectors of the associated equipment will be initial upper-case letters only (e.g., waveform monitor A Input).

The procedure is arranged in a sequence that depends upon previous control settings and connections, and should be performed in sequence. There are, however, certain places where all equipment is disconnected, allowing an operator to start the procedure at this point if desired.

NOTE

The following procedure uses the equipment listed. If substitute equipment is used, control settings and/or connections may need to be altered.

Procedure

1. Remove the REMOTE plug, P9014, from the rear-panel REMOTE connector J9014. (See INSTALLATION; Local-Remote Connector, in this section for details.)

2. Set the 147 front-panel controls and rear-panel control as follows:

PROGRAM CONTROL	
UNITY GAIN/VAR	UNITY GAIN
PROGRAM/ PREVIEW/ AUXILIARY	PROGRAM
LOCAL/REMOTE	LOCAL
NOISE AND PEDESTAL	
NOISE	DELECTION
PEDESTAL	100 IRE
NOISE LEVEL dB	OFF, O
MULTIBURST AMPLITUDE	NORMAL
LINEARITY	
SUBCARRIER	ON
Mode	5 STEP
FULL FIELD SIG	
Mode	LINEARITY
APL	BOUNCE 10-90
VARIABLE	O
POWER	OFF
SYNC SOURCE	Up (Program Line In)

3. Check for correct positioning of the 147 rear-panel Range and Voltage Selectors. (see INSTALLATION; Operating Voltage, in this section for details.) These must be in agreement for the power source to be used. Connect the 147 to the power source via the three-conductor power cord supplied with the 147.

4. Set the POWER switch ON. Note that the green power-on indicator lamp is lit, to indicate power is being supplied to the instrument; note that the red NON-SYNCHRONOUS MODE—NO VITS lamp is lit, indicating lack of Gen-Lock.

NOTE

Without Gen-Lock, the 147 will not delete or insert VITS.

5. From the 147 FULL FIELD SIG OUT connector, connect a 75 Ω cable to the waveform monitor A Input connector. Terminate the loop-thru A Input with a 75 Ω end-line termination.

6. Observing the waveform monitor at a 2 Field Display rate, note that comp sync and burst are the only signals being generated.

NOTE

Black Burst is the only signal available at FULL FIELD OUTPUTS with REMOTE PLUG removed.

7. Connect the REMOTE plug, P9014, to the rear-panel REMOTE connector J9014.

8. Observing the waveform monitor, note that Full Field signals are being generated by the 147. Observe the display at a 2 Line display rate. The display should be the 5 Step LINEARITY test signal, similar to that shown in Fig. 1-2 of this manual.

NOTE

Without proper connection to the REMOTE connector, Full Field signals will not be generated.

9. Switch the 147 LINEARITY controls. The display will be either the 5 Step, 10 Step or Ramp LINEARITY signal with or without modulation as determined by the setting of the SUBCARRIER switch. Return the LINEARITY switches to produce the 5 Step, with modulation, LINEARITY signal.

10. Set the FULL FIELD SIG mode switch to FLAT FIELD. Observing the waveform monitor display for several

seconds, notice that the display consists of sync, burst, and a square wave. The square wave should automatically bounce between 10 and 90 IRE. Using a small screwdriver, rotate the front-panel RATE control fully counter-clockwise. Note that the time now required for the square-wave to bounce between 10 and 90 IRE is slow (approximately 15 seconds). Turn the RATE control fully clockwise. The rate of bounce should have increased (approximately 1 second). Set the RATE control as desired.

11. Set the APL switch to VARIABLE. The display will consist of burst and sync only. Observing the display, rotate the VARIABLE switch to 10, then 20. Notice that the square wave increases in amplitude as the VARIABLE is increased. This control allows the operator to select any APL level desired in 10 IRE increments between 0 and 100 IRE. Notice the (50) position of this switch between 0 and 100. As a convenience to the operator, this position allows standard 10-50-90 APL measurements to be made without completely rotating the switch 360°. Observe the display at a 2 Field display rate. The FLAT FIELD signal should occupy all active video lines. Return the waveform monitor for a 2 Line display rate; set the 147 VARIABLE switch to 50 IRE.

12. Set the 147 FULL FIELD SIG mode switch to FIELD SQ WAVE. Notice that the display is similar to the FLAT FIELD signal, except the square wave is at 100 IRE at all times. Observe the display at a 2 Field display rate. Notice that the square wave does not occupy all active video lines. Only lines 57 through 227 of each field are used. Return the monitor for a 2 Line display.

13. Set the 147 FULL FIELD SIG mode switch to WINDOW. This signal will be similar to that shown in Fig. 1-2 of this manual. It consists of the 2T pulse, modulated 12.5T pulses and a Bar. Observe the display at a 2 Field display rate. Notice the 2T and modulated 12.5T pulses occur each active line of both fields, but the Bar occurs only part of the time. The Bar portion of this signal occupies lines 66 through 218 of each field. Set the monitor for a 2 Line display.

14. Set the 147 FULL FIELD SIG mode switch to SIN^2 PULSE AND BAR. This signal should be similar to the WINDOW signal observed in step 13. Observe the display at a 2 Field display rate. Notice that the Bar occupies all active video lines. This is the only difference between SIN^2 PULSE AND BAR and the WINDOW signal. Return the monitor for a 2 Line display.

15. Set the 147 FULL FIELD SIG mode switch to COMPOSITE. The display should be similar to that shown in Fig. 1-2 of this manual. It consists of the 5 Step Staircase (LINEARITY) and the SIN^2 PULSE AND BAR signal. Only the line timing has been changed on these signals. Switch the LINEARITY controls. Notice the 5 Step Staircase cannot be changed, but the modulation on the steps correspond to the setting of the SUBCARRIER switch. Return the LINEARITY switches to 5 STEPS and SUBCARRIER ON.

16. Set the 147 FULL FIELD SIG mode switch to MULTIBURST. This signal should be similar to that shown in Fig. 1-2 of this manual. The signal occupies all active video lines of both fields. Set the MULTIBURST AMPLITUDE switch to REDUCED. Notice the reduced peak to peak amplitude of each burst packet and the level about which the burst packets are centered. The white level should remain at 100 IRE. Return the MULTIBURST AMPLITUDE switch to NORMAL.

17. Set the 147 FULL FIELD SIG mode switch to NOISE. This signal is controlled by the NOISE AND PEDESTAL switches and controls. Set the PEDESTAL (IRE) switch to 50, then 10, and back to 100. Note that the pedestal amplitude corresponds to the setting of this switch. (In the DELETION mode, this is the only switch affecting the signal.) Set the NOISE switch to INSERTION. The display should be similar to that obtained in the DELETION mode. Rotate the VAR control. Note that the pedestal level can be changed approximately ± 10 IRE about the level determined by the setting of the PEDESTAL switch. Set the NOISE LEVEL dB OFF/−20 switch to −20. Notice that noise has been added on the pedestal. Rotate the NOISE LEVEL dB 9/0 switch. There should be a decrease in noise level. These two dB switches provide noise attenuation from −20 dB to −59 dB in 1 dB steps. (700 mV RMS = 0 dB.) Set the dB switches to −20 and 0. Rotate the VAR control to center the NOISE about the 100 IRE level.

NOTE

In steps 8 through 17, each FULL FIELD SIG OUT has been demonstrated. These same signals are also available at the rear-panel FULL FIELD TEST SIGNAL OUTPUT.

18. Disconnect the 75 Ω cable from the OUT connector and reconnect it to the NOISE OUT connector. Observing the monitor display, switch the NOISE and PEDESTAL switches. Note the signal is controlled only by the NOISE LEVEL dB switches and that the signal is continuous (e.g., no line or field sync).

19. Disconnect the 75 Ω cable from the NOISE OUT connector and reconnect it to the rear-panel COMPOSITE SYNC connector. There should be no display, as the 147 must be Gen-Locked to provide composite sync to this connector.

20. Disconnect the 75 Ω cable from the rear-panel COMPOSITE SYNC connector and reconnect it to the CW SUBCARRIER OUT connector. Disconnect the 75 Ω cable from the waveform monitor A Input and connect it to the Vectorscope CH A J1 Input connector; terminate the other CH A J2 connector with a 75 Ω end-line termination. There should be no vector display, as the 147 must be Gen-Locked to provide CW to this connector.

21. Disconnect all connections.

NOTE

In the steps to follow this procedure will, where possible, simulate the actual in-service operation of the 147.

22. Using 75 Ω cables and 75 Ω end-line terminations make the following connections:

a. 147 PROGRAM LINE OUT to waveform monitor A Input; waveform monitor A Input loop-thru to Vectorscope CH A J1 connector; terminate Vectorscope CH A J2 connector into 75 Ω.

b. 147 PREVIEW MONITOR OUT to waveform monitor B Input; waveform monitor B Input loop-thru to Vectorscope CH B J50 connector; terminate Vectorscope CH B J51 connector into 75 Ω.

c. Type 140 (external video source) Subcarrier to Vectorscope Ext CW ϕ Ref J310 connector; terminate Vectorscope Ext CW ϕ Ref J311 into 75 Ω.

d. Type 140 (external video source) Comp Sync to waveform monitor Ext Neg Sync Input; waveform monitor Ext Neg Sync Input Loop-thru to Vectorscope Ext Sync J120 connector; terminate Vectorscope Ext Sync J121 connector into 75 Ω.

e. Type 140 (external video source) Comp Video to 147 PROGRAM LINE IN connector.

23. Set the 147 controls and switches as given in step 2, except set the POWER switch ON and the PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch to PREVIEW. Set the Vectorscope to view the CH A Input in a vector mode using external sync and ϕ Reference. Set the waveform monitor to view the A Input at a 2 Line display rate, using external sync with line 20 of field one selected. Set the external video source to provide Full Field color bars with a color bar VIT on line 20.

24. Observe the 147 front-panel. The NONSYNCHRONOUS MODE—NO VITS lamp should be extinguished. This indicates the 147 has been Gen-Locked with the external video, and is capable of deleting and inserting internally generated VITS.

NOTE

If this lamp is lit, check the 147 rear-panel SYNC SOURCE switch position. It must be in the upper position (this permits synchronization via the 147 PROGRAM LINE IN).

25. Notice that the 147 front-panel PREVIEW lamp is lit to indicate status (lamp extinguished indicates relay not energized). In this mode of operation, program video to the PROGRAM LINE IN is being passed to the PROGRAM LINE OUT without interruption as indicated by the waveform monitor and vectorscope displays. Observe the waveform monitor at a Field .125 H/Cm display rate. The external color bar VIT should be on line 20 of field one.

26. Observe the waveform monitor B Input (PREVIEW MONITOR). VIRS should be present on line 20 of field one. This signal is similar to that shown in Fig. 1-2 of this manual. Also, note that the 147 front-panel VIRS INCOMING lamp is extinguished and (2) the VIRS INSERT and VIRS DELETE lamps are lit. This indicates (1) the external video source does not contain a VIRS, and (2) if the external video source contains a VIT signal on the line programmed for VIRS, it will be deleted and replaced by the internally generated VIR.

NOTE

The signal appearing at the PREVIEW MONITOR OUTPUT allows operating personnal to observe the actual signal after insertion without actually going to an 'on the air' mode of operation.

27. Using Table 2-2, check that all VIT signals, as factory programmed, are being inserted on the proper line and field. Continue to observe the B Input at a Field .125 H/Cm display rate.

TABLE 2-2

147 FACTORY VITS PROGRAMMING

LINE	FIELD	SIGNAL
18	1	MULTIBURST
18	2	NOISE[3]
19	1	COMPOSITE
19	2	LINEARITY
20	1 & 2	VIRS
21	1	Full Line Deletion
21	2	1/2 Line Deletion

[3] NOISE will be displayed in the center half of line 18 only, and will be dealt with later in the procedure.

28. Set the 147 PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch to PROGRAM. Observing the waveform monitor A Input (PROGRAM LINE OUT), notice that the internally generated VIT signals have been applied to the 'on the air' signal. Note that the 147 front-panel PROGRAM CONTROL PROGRAM lamp is lit to indicate status.

29. Set the waveform monitor to view line 20 of field 1. Observing the display, set the 147 POWER switch to OFF. Notice the color bar VIT has returned. This indicates external video has bypassed the 147, and demonstrates the fail-safe characteristic of the 147 should loss of power, sync, etc., occur during an 'on the air' (PROGRAM) situation. Return the 147 POWER switch to ON.

30. Set the waveform monitor to observe line 18 of field two, using the A Input (PROGRAM MONITOR). Set the external video source to provide a 50 IRE Bar VIT on line 18 of field 2. (If using the Type 140, set the Mod Staircase 0° Subcarrier and Steps switches down and the APL switch to 50; this will produce the 50 IRE Bar.) Set the 147 controls as follows: PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY to PREVIEW; NOISE to INSERTION; PEDESTAL to 100; NOISE LEVEL dB to −20 and 0; FULL FIELD SIG Mode to NOISE. The display should be similar to that shown in Fig. 2-5A. Next, set the waveform monitor to view the B Input (PREVIEW MONITOR). The display should appear similar to that shown in Fig. 2-5B. Change the NOISE AND PEDESTAL switches and control; their effect should be as demonstrated using the Full Field signal. This signal allows 'on the air' noise measurements to be made during the vertical interval, by deleting the center portion of the external VIT and inserting internal noise which is of known amplitude for comparison purposes.

31. Set the waveform monitor for a 2 Line Display rate. Notice that each active video line contains the external video signal with interruptions for noise. Set the 147 FULL FIELD SIG Mode switch to any position other than NOISE. Each active line should contain only the external video. Return the FULL FIELD SIG Mode switch to NOISE.

NOTE

The signal appearing at the PREVIEW MONITOR OUTPUT is available in the PREVIEW MODE ONLY.

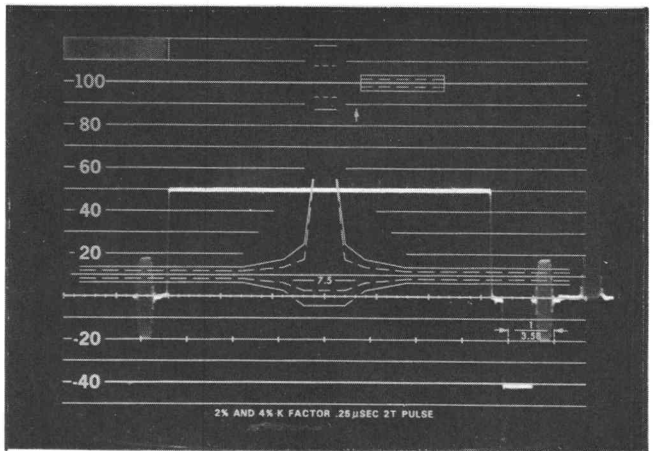
32. Set the 147 PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch to PROGRAM, and the waveform monitor to display the A Input (PROGRAM LINE OUT). The display should contain only the external video. Set the waveform monitor for a Field .125 H/Cm Display rate. Again, the display should appear similar to that shown in Fig. 2-5B.

33. Set the external video source to provide a color bar VIT on line 17 of field 1. As factory programmed, the 147 will delete this VIT as indicated by the waveform monitor display. Line 17 of field one has been reserved for an externally applied VIT only. (See Operating Options in this section for details.)

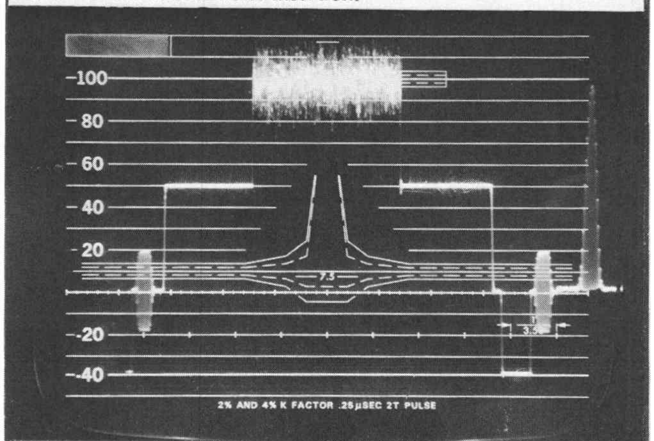
34. Connect an external color bar VIT signal to the 147 rear-panel EXT VITS IN connector via a 75 Ω cable. The VIT should be on line 17 of field one. (If using the Type 140, use the unused Comp Video Output for this signal.) The color bar VIT should now be displayed on the waveform monitor.

NOTE

The following step (No. 35) demonstrates the effect of applying an external VIT (to the 147 EXT VITS IN) on the same line and field as the internally generated VIT. The VITS applied to the EXT VITS IN should ONLY be on that line and field which has been programmed for external VITS.



(A) VIT Bar before noise insertion.



(B) VIT Bar with inserted noise measurement signal.

Fig. 2-5. Typical waveform monitor displays of (A) APL VIT without noise and (B) APL VIT with noise measurement signal.

35. Set the externally video source to provide the external color bar VIT on line 18 of field one. Set the waveform monitor to view line 18 of field one. The display should now be distorted. Disconnect the 75 Ω cable to the 147 rear-panel EXT VITS IN. The display should now be the MULTIBURST VIT without distortion. Reconnect the 75 Ω cable to the EXT VITS IN and set the external video source to provide the external VIT on line 17 of field one.

36. Observing the waveform monitor A Input at a 2 Field Display rate and the Vectorscope CH A Input vectors (both are PROGRAM LINE OUTPUTS), set the 147 PROGRAM CONTROL UNITY GAIN/VAR switch to VAR and rotate the LEVEL control. The amplitude of the external video can now be varied with the LEVEL control. Observe the waveform monitor display of the vertical interval with X25 magnification. Rotation of the 147 LEVEL control should not affect internally-generated VITS. Turn off the waveform monitor magnification and adjust the LEVEL control for a signal amplitude of 140 IRE peak to peak. (The LEVEL control allows the operator to match incoming program material to the internally generated signals.) Return the PROGRAM CONTROL to UNITY GAIN.

37. Observing the Vectorscope display, use a small screwdriver and rotate the 147 PROGRAM CONTROL INSERT SUBCARRIER PHASE control. There should be a vector representing internally generated subcarrier which is controlled by rotation of this control. Superimpose this vector with the vector representing external subcarrier. The INSERT SUBCARRIER PHASE control enables the operator to match the phase of the internally generated subcarrier to the phase of the external subcarrier.

38. Set the 147 PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch to AUXILIARY and view the waveform monitor B Input (PREVIEW MONITOR) at a 2 Line Display rate. Sync and burst will be double amplitude. As explained under Controls and Connectors, when in AUXILIARY mode of operation with an external VIT to the EXT VITS IN connector, there must be no sync or burst added with the external VIT. Disconnect the 75 Ω cable from the EXT VITS IN connector. Sync and burst should now be normal amplitude.

39. Observing the waveform monitor display, rotate the 147 PROGRAM CONTROL AUXILIARY PEDESTAL control. The peak amplitude of the displayed square wave (pedestal) can now be varied between 0 and 100 IRE. Disconnect the 75 Ω cable from the rear-panel PREVIEW MONITOR OUTPUT and reconnect it to the PROGRAM MONITOR OUTPUT connector. Rotate the AUXILIARY PEDESTAL control. Again the pedestal amplitude can be varied between 0 and 100 IRE. Observing the waveform monitor A Input (PROGRAM LINE OUT), notice that external color bars are displayed and rotation of the AUXILIARY PEDESTAL control has no effect. The Auxiliary signal will be only applied to the PREVIEW and PROGRAM MONITOR OUTPUTS with the PROGRAM LINE IN bypassed through the relay to the PROGRAM LINE OUTPUT. This is the only mode where the PROGRAM MONITOR OUTPUT does not contain the same signal as the PROGRAM LINE OUTPUT. Set the waveform monitor to view the B Input (PROGRAM MONITOR).

40. Apply a color bar signal via a 75 Ω cable to the 147 AUX IN connector. (If using the Type 140, use the same signal applied to the EXT VITS IN from the Comp Video Output.) The external applied color bar has been added on the pedestal level of the auxiliary signal. Rotate the AUXILIARY PEDESTAL control. The pedestal on which the external color bar is riding can again be changed between 0 and 100 IRE with rotation of this control. This input, although demonstrated using a color bar, can be driven by any signal desired for a specific application such as a sweep generator, etc.

41. Set the 147 PROGRAM CONTROL REMOTE/LOCAL switch to REMOTE. Note that the 147 PROGRAM CONTROL PREVIEW lamp is lit to indicate status. Observe the waveform monitor at first a 2 Line Display rate, then a 2 Field display rate. The display should contain only the external video signal. Switch the PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY to any position. There should be no change to the displayed output.

NOTE

With the PROGRAM CONTROL REMOTE/LOCAL switch set to REMOTE, control is via the rear-panel REMOTE connector. As factory connected, the 147 operates in PREVIEW.

42. Set the 147 switches and controls as given in step 2 of this procedure, except set the POWER switch ON, PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch to PROGRAM, and the rear-panel SYNC switch down. Observing the waveform monitor B Input at a 2 Field Display rate, notice that only the external video is being passed by the 147. Also, note the front-panel NONSYNCHRONOUS MODE-NO VITS lamp is lit, indicating lack of Gen-Lock. Under this condition, the 147 will not insert or delete.

43. Disconnect the external color bar signal from the 147 AUX IN connector and reconnect it to the rear-panel BLACK BURST INPUT connector; terminate the other BLACK BURST INPUT Loop-Thru connector into 75 Ω. Set the external sync source to obtain 'Black Burst'. (If using the Type 140, set the Video switch to Off.) The 147 NONSYNCHRONOUS MODE-NO VITS lamp should be ex-

tinguished, and the waveform monitor should be displaying the inserted VITS.

44. Set the waveform monitor to view line 20 of field one of the A Input at a Field .125 H/Cm Display rate. The VIRS will be displayed. Using a small blade screwdriver, rotate the 147 INSERT DELAY control. The position on the line of the VIR signal can be changed, thus allowing the operator to control time positioning of internally generated VITS with respect to the incoming signal.

45. Disconnect all test equipment and set the 147 controls and switches as given in step 2 of this procedure, except set the POWER switch ON and the PROGRAM CONTROL PROGRAM/PREVIEW/ AUXILIARY switch to PROGRAM, and the rear-panel SYNC switch down.

NOTE

The following demonstrates if the 147 will accept and display an external VIR. It is not intended that the operator use the instrument in the manner described.

46. Connect an external Black Burst signal to the 147 rear-panel BLACK BURST IN connector; terminate the other BLACK BURST IN connector into 75 Ω. Connect a 75 Ω cable between the rear-panel FULL FIELD TEST SIGNAL OUTPUT connector and the rear-panel PROGRAM LINE IN connector.

47. Notice the 147 front panel VIRS INCOMING, VIRS DELETE, AND VIRS INSERT lamps; each should be flickering. This merely indicates that the VIRS INCOMING circuits are working properly. If an external VIR were used, these lights would stay on to indicate VIR status. (Refer to Operating Options in this section for additional details.)

48. This completes the first time operation. Disconnect all connections.

OPERATING CHANGES

General Information

The 147 is factory connected to produce the output signals which are most frequently used by the television industry. However, the 147 is versatile, in that many internal changes can be made which alter these signals to meet certain applications. For example, the COMPOSITE signal (both Full Field and VIT) as shipped from the factory generates and displays the 5 Step Staircase as a portion of the total signal. This may be internally changed to provide the ramp signal (in place of the staircase) on the COMPOSITE signal.

The following provides the information necessary to change or modify the 147 where possible.

NOTE

Some of the changes or modifications that follow require internal adjustment to comply with industry standards. It is recommended that only qualified personal, thoroughly familiar with calibration procedures and the video signals, make these changes.

VITS Line & Field Selection

VITS may be selected to appear on lines 10 through 21 of field one, field two, or both fields. Line and Field selection is accomplished by selecting various internal quick-change pin connectors on the 147 VIT & FF circuit board. As factory-connected, the 147 provides MULTIBURST on line 18 of field one, NOISE on line 18 of field two, COMPOSITE on line 19 of field one, LINEARITY on line 19 of field two, and VIRS on line 20 of both fields.

Referring to Fig. 2-6, notice that the upper three rows of pins are contained in six columns (two pins per column row) and labeled BOTH, 1 and 2. Connection between any two pins in a column row determines the field on which a particular VIT will be displayed. Directly below (and slightly left) of the upper three rows are 13 rows of pins contained in five columns (two pins per column row) and labeled (starting top to bottom) OFF, 21 . . .11, and 10. Connection between any two pins in a column row determines the line on which a particular VIT will occupy. Any VITS, except VIRS, must therefore have two connections (field and line) to be displayed. To prevent or disable a particular VIT, except VIRS, move the line connector to the OFF row.

The field and line columns are also labeled (starting right to left) SPARE 1, SPARE 2, COMPOSITE, MULTIBURST, NOISE, and VIRS. (VIRS has only field pins.) Each has been assigned colored pin connectors which are brown, red, orange, yellow, green, and blue respectively. This coding simplifies identifying the various VIT signals, and any same-color connector (except black) on the 147 VIT & FF circuit board will affect only that particular signal.

The following information details each VIT signal available.

VIRS: Internally set to appear on line 20. Operating personnel may select field one, field two, or both fields.

NOISE, MULTIBURST, COMPOSITE: Operating personnel may select any line from 10 through 21 of field one, field two or both fields.

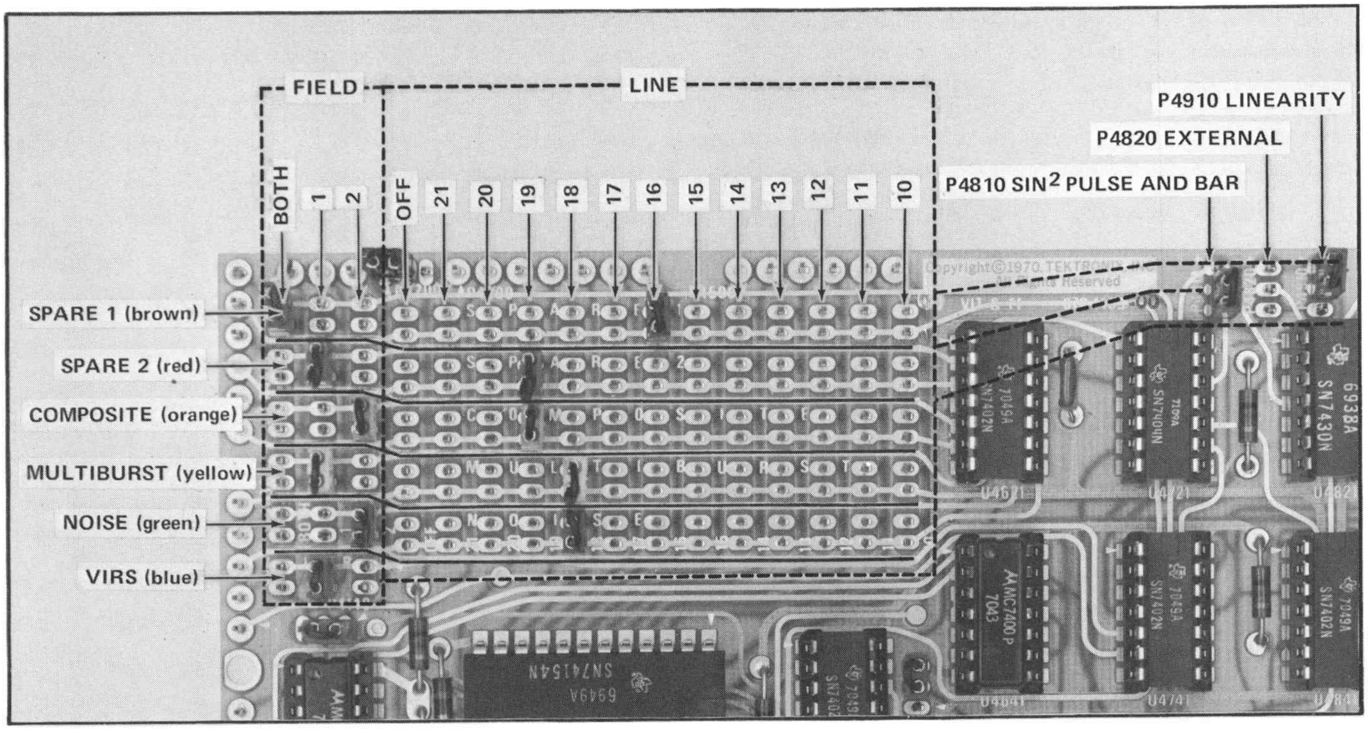


Fig. 2-6. 147 VIT and FF circuit board showing location of VIT LINE and FIELD selector plugs.

SPARE 2: Operating personnel may select any line from 10 through 21 of field one, field two, or both fields for (1) LINEARITY, (2) SIN^2 PULSE AND BAR, or (3) EXT VIT signals as follows:

> Factory connected, the LINEARITY VIT signal occupies line 19 of field two. Pins two and three of P4910 are connected. (See Fig. 2-6 for location of P4910.) To display one of the other two signals (2) or (3), remove the connector between pins two and three of P4910 and reconnect it to pins two and three of P4810 to obtain the SIN^2 PULSE AND BAR (2) or between pins two and three of P4820 for an EXT VIT (3).

SPARE 1: Operating personnel may select any line from 10 to 21 of field one, field two, or both fields for the above listed signals (1), (2), or (3). Selection is accomplished as for SPARE 2, except all connections must be made between pins one and two.

NOTE

To delete a VIT, program for EXT VIT and do not put an EXT VIT into the 147 EXT VITS IN connector.

VIT Cover

As a convenience to the operator, a VIT Program cover is supplied with the 147 with factory connected VITS written in; see Fig. 2-4 of this manual. This cover can be removed, and the front panel will consist of an array of write-in spaces where the internal line and field addresses of the VIT signals may be indicated as programmed by the operator.

Line 21 Deletion/Pass

As factory connected, any incoming signal which occupies line 21 of either field will be deleted as follows: line 21 of field one, all active line time; line 21 of field two, first one-half of active line time. To pass line 21 of either field, disconnect the connector between pins two and three of P4200 (see Fig. 2-7) and reconnect it between pins one and two.

External VIRS Detection & Opposite Field Preview

The following options have been grouped together because of interaction between them. They are also dependent upon the presence or absence of an external VIRS to the PROGRAM LINE IN, and upon the 147 internal field programming for VIRS.

The position of the connector on P4140 (see Fig. 2-7) determines which field of the incoming signal is detected for VIRS. Field one detection is obtained by connecting the connector between pins two and three; field two detection is obtained by connecting between pins one and two.

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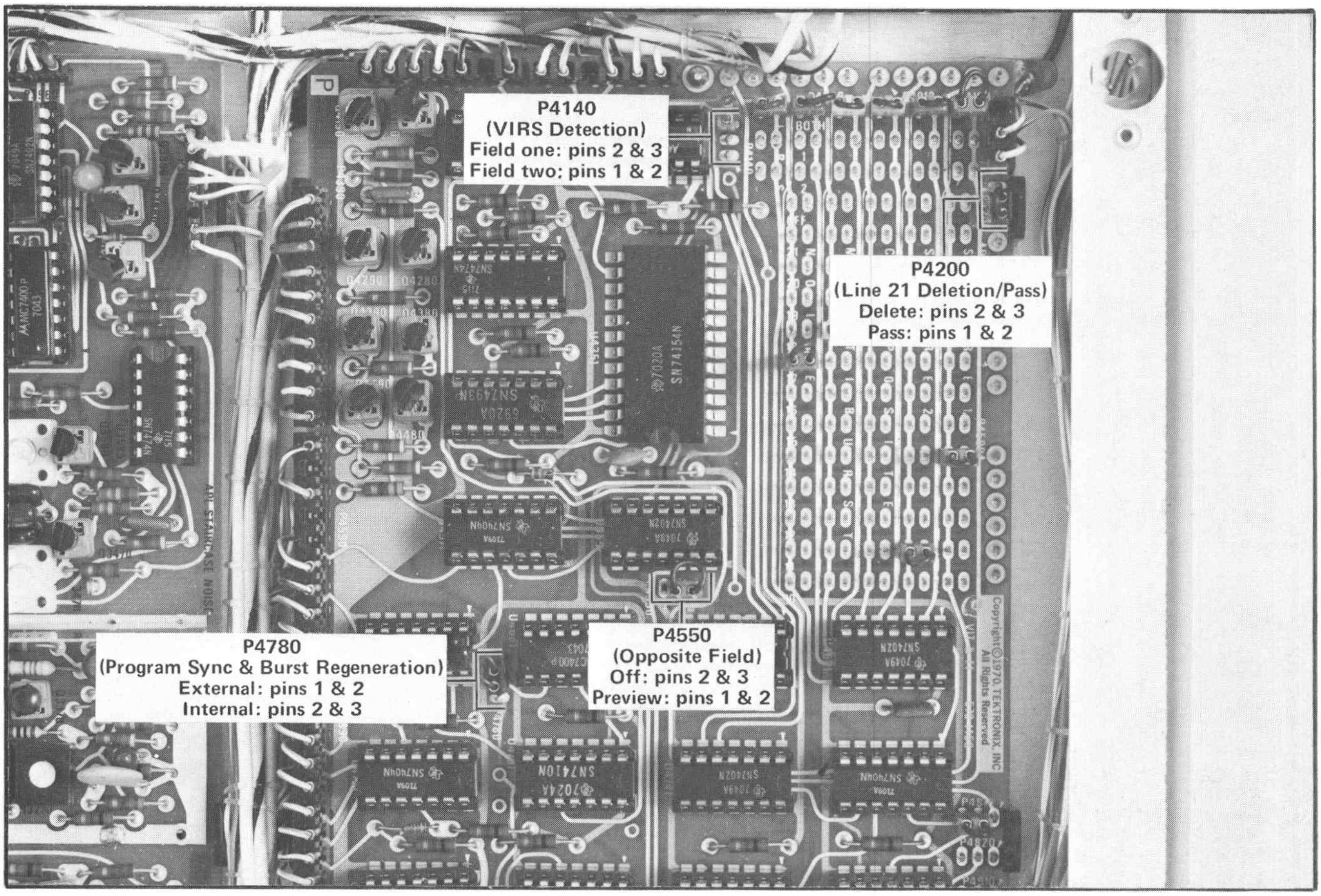


Fig. 2-7. 147 VIT & FF circuit board showing location of VIRS Detection, Opposite Field Preview, and Line Deletion plugs.

The position of the connector on P4550 determines whether internal VIRS will be inserted on the opposite field from external VIRS in the PREVIEW mode of operation. Connecting pins one and two of P4550 allow insertion (Preview); pins two and three connected will not.

Table 2-3 lists the various conditions under which this option is effective.

NOTE

With (1) no external VIRS in or (2) 147 VIRS programmed for BOTH fields, the Opposite Field Preview is inoperative.

Horizontal Programming

The 147 is versatile, in that any signal generated may be internally reprogrammed, using quick change connectors, to produce signals which are timed according to specific user applications. Fig. 1-2 (Section 1 of this manual) shows the signals generated by the 147 along with all timing information.

Using the COMPOSITE test signal as an example, notice that the horizontal axis has been plotted in microseconds from 0 to 64 (in NTSC, this is actually 63.56 μs, the difference to be explained later) with 10, 14, 17, 20, 23, 26, 29, 32, 36, 38, 44, and 62 listed in the illustration. Each of these listed times corresponds to a particular portion of the complete signal, which can be reprogrammed as desired. In other words, the 2T pulse might be reprogrammed to start at 10 μs, or completely eliminated.

Characteristic Instants

All signal programming is controlled by selection of various gate signals derived by the 147 Horizontal Counter. These gate signals are brought to circuit board pins for easy access. The pins are shown in Fig. 2-8. There are three groups of pin connectors; Instant, +, and 1/2 Instant. The first group, Instant, is arranged to provide 32 columns with nine rows of pins per column row. These columns are numbered, left to right, 3, 4,. . . .32, 1, and 2. Each number is a Characteristic Instant and is exactly equal to

$$\frac{63.56\ \mu s}{32}\ (1.98606\ \mu s),$$

TABLE 2-3

EXTERNAL VIRS DETECTION & OPPOSITE FIELD PREVIEW

VIRS FIELD PROGRAMMING		OPTIONS		147 PROGRAM CONTROL			
		VIRS DETECTION (P4140)	OPPOSITE FIELD (P4550)	PREVIEW MODE; PREVIEW MONITOR VIRS		PROGRAM MODE; PROGRAM MONITOR VIRS	
INT	INCOMING			FIELD ONE	FIELD TWO	FIELD ONE	FIELD TWO
1	1	1	PREVIEW	EXT	INT	EXT	NONE
1	1	1	OFF	EXT	NONE	EXT	NONE
2	2	2	PREVIEW	INT	EXT	NONE	EXT
2	2	2	OFF	NONE	EXT	NONE	EXT
1	BOTH	1	PREVIEW	EXT	INT	EXT	EXT
1	BOTH	1	OFF	EXT	EXT	EXT	EXT
1	BOTH	2	PREVIEW	EXT	INT	EXT	EXT
1	BOTH	2	OFF	EXT	EXT	EXT	EXT
2	BOTH	1	PREVIEW	INT	EXT	EXT	EXT
2	BOTH	1	OFF	EXT	EXT	EXT	EXT
2	BOTH	2	PREVIEW	INT	EXT	EXT	EXT
2	BOTH	2	OFF	EXT	EXT	EXT	EXT

NOTE

With P4550 in OFF (Pins 2 and 3), PREVIEW & PROGRAM are the same.

or approximately 2 μs. The Characteristic Instant, therefore, represents the time axis of Fig. 1-2, and is the reason for an apparent H Rate of 64 μs.

The second group of pins, + (P2730), contains three pins. This column is used to connect unused inputs. Its use will be explained shortly. The third group, 1/2 Instant (P2950), contains two pins which are internally connected to provide a 1/2 Characteristic Instant (1 μs) timing change. This will also be covered in the example to follow.

Table 2-4 lists the programming as factory-connected, and for obvious reasons, all wires and connectors used to program the 147 are color coded. Use of Table 2-4 will be covered in the following example.

NOTE

Reprogramming of some signals may require internal calibration. It is recommended that only qualified personnel, thoroughly familiar with the different signal characteristics and calibration procedures, perform these programming changes.

The following example uses the staircase portion of the COMPOSITE signal and involves all three groups of Characteristics (instants). It is assumed that the staircase portion of this signal has (1) been completely disabled e.g., all programming wires associated with this signal are disconnected, and (2) the staircase signal will be programmed to provide the same timing as that shown in Fig. 1-2 of this manual.

Proceed as follows:

a. Referring to Table 2-4, scan the SIGNAL AFFECTED column for all possible connections. These are (1) STEPS, COMPOSITE, ENABLE SET; (2) STEPS, COMPOSITE, ENABLE RESET; (3) STEPS MODULATION, Composite, SET; (4) STEPS MODULATION, Composite, RESET; (5) COMPOSITE LINEARITY 1st. LEVEL SET; (6) COMPOSITE LINEARITY 2nd & 4th LEVEL SET; (7) COMPOSITE LINEARITY 3rd LEVEL SET; (8) COMPOSITE LINEARITY 5th LEVEL SET; and (9) COMPOSITE LINEARITY LEVEL SET.

b. Directly opposite the SIGNAL AREA column of each possible connection found in part a, note the wire and connector COLOR CODE and the TIMING instant and μs column. For (1) a 9-4 wire with a 0 connector, when connected to instant 4 on the 147 Horizontal Circuit board (see Fig. 2-8) will enable the staircase portion of the COMPOSITE signal to be displayed. Connect the (2), (3), (5), (7), and (8) wires.

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TABLE 2-4

FACTORY HORIZONTAL PROGRAMMING

COLOR CODE*		TIMING		SIGNAL AFFECTED
WIRE	CONNECTOR	INSTANT	µSEC	
9–03	0	12	24	NOISE SET
9–18	0	24	48	NOISE RESET
9–5	0	5	10	HORIZ BLANK SET
9–34	0	31	62	HORIZ BLANK RESET
9–6	0	6	12	VIRS MODULATION SET
9–08	0	17	34	VIRS MODULATION RESET
9–03	1	12	24	BAR (Pulse & Bar) SET
9–23	0	25	50	BAR (Pulse & Bar) RESET
9–8	0	8	16	RAMP (Linearity) SET
9–26	0	28	56	RAMP (Linearity) RESET
9–6	1	6	12	12.5T (Pulse & Bar) SET
9–8	1	8	16	12.5T (Pulse & Bar) RESET
9–6	2	6	12	VIRS 70% SET
9–12	0	18	36	VIRS 70% RESET
9–6	3	6	12	VIRS 50% SET
9–18	1	24	48	VIRS 50% RESET
9–5	1	5	10	MULTIBURST 100% SET
9–8	2	8	16	MULTIBURST 100% RESET
9–16	0	22	44	BAR (Composite) SET
9–34	1	31	62	BAR (Composite) RESET
9–6	4	6	12	VIRS 7.5% SET
9–28	0	30	60	VIRS 7.5% RESET
9–8	4	8	16	MULTIBURST 55% SET
9–34	2	31	62	MULTIBURST 55% RESET
9–07	0	16	32	PHASE SWITCH SET
9–34	3	31	62	PHASE SWITCH RESET
9–13	0	19	38	12.5T (Composite) SET
9–15	4	21	42	12.5T (Composite) RESET
9–02	0	11	22	MULTIBURST 0.5 MHz SET
9–06	1	15	30	MULTIBURST 1.5 MHz SET
9–12	1	18	36	MULTIBURST 1.5 MHz RESET
9–12	2	18	36	MULTIBURST 2.0 MHz SET
9–15	1	21	42	MULTIBURST 2.0 MHz RESET
9–15	2	21	42	MULTIBURST 3.0 MHz SET
9–18	2	24	48	MULTIBURST 3.0 MHz RESET
9–18	3	24	48	MULTIBURST 3.58 MHz SET
9–25	0	27	54	MULTIBURST 3.58 MHz RESET
9–25	1	27	54	MULTIBURST 4.2 MHz SET
9–34	4	31	62	MULTIBURST 4.2 MHz RESET
9–4	0	4	8	STEPS (Composite) ENABLE SET
9–07	1	16	32	STEPS (Composite) ENABLE RESET
9–5	2	5	10	STEPS MODULATION (Composite) SET
9–38	0	14.5	29	STEPS MODULATION (Composite) RESET
9–05	3	5	10	STEPS MODULATION (Linearity) SET
9–27	0	29	58	STEPS MODULATION (Linearity) RESET
9–0	0	9	18	LINEARITY 10 STEP 1ST LEVEL SET
9–02	2	11	22	LINEARITY 10 STEP 2ND LEVEL SET
9–04	1	13	26	LINEARITY 10 STEP 3RD LEVEL SET
9–06	3	15	30	LINEARITY 10 STEP 4TH LEVEL SET
9–08	2	17	34	LINEARITY 10 STEP 5TH LEVEL SET
9–13	1	19	38	LINEARITY 10 STEP 6TH LEVEL SET
9–15	3	21	42	LINEARITY 10 STEP 7TH LEVEL SET
9–17	0	23	46	LINEARITY 10 STEP 8TH LEVEL SET
9–23	1	25	50	LINEARITY 10 STEP 9TH LEVEL SET
9–25	2	27	54	LINEARITY 10 STEP 10TH LEVEL SET
9–7	0	7	14	COMPOSITE (Linearity) 1ST LEVEL SET
9–36	0	8.5/11.5	17/23	COMPOSITE (Linearity) 2ND & 4TH LEVEL SET
9–01	0	10	20	COMPOSITE (Linearity) 3RD LEVEL SET
9–04	0	13	26	COMPOSITE (Linearity) 5TH LEVEL SET
9–45	0	+	—	COMPOSITE (Linearity) LEVEL SET
9–01	1	10	20	PULSE (Pulse & Bar) SET
9–12	3	18	36	PULSE (Composite) SET
9–05	0	14	28	1/2 INSTANT DELAY
9–8	3	8	16	2 INPUT 1/2 INSTANT DELAY
9–02	1	11	22	

KEY TO TABLE

INSTANT	WIRE
1	9–1
2	9–2
3	9–3
4	9–4
5	9–5
6	9–6
7	9–7
8	9–8
9	9–0
10	9–01
11	9–02
12	9–03
13	9–04
14	9–05
15	9–06
16	9–07
17	9–08
18	9–12
19	9–13
20	9–14
21	9–15
22	9–16
23	9–17
24	9–18
25	9–23
26	9–24
27	9–25
28	9–26
29	9–27
30	9–28
31	9–34
32	9–35
+	9–45
1 INPUT	9–36
2 INPUT	9–38

COLOR CODE*

Code	Color
0	BLACK
1	BROWN
2	RED
3	ORANGE
4	YELLOW
5	GREEN
6	BLUE
7	VIOLET
8	GRAY
9	WHITE

*Used with Wire & Connector

Example: A wire connected to INSTANT 24 has a wire color code of 9–18 and is read, BROWN-GRAY on WHITE. If this wire is the only connection to INSTANT 24, it will have a black connector. The second wire to INSTANT 24 will be 9-18/1 and read, BROWN-GRAY on WHITE with BROWN connector.

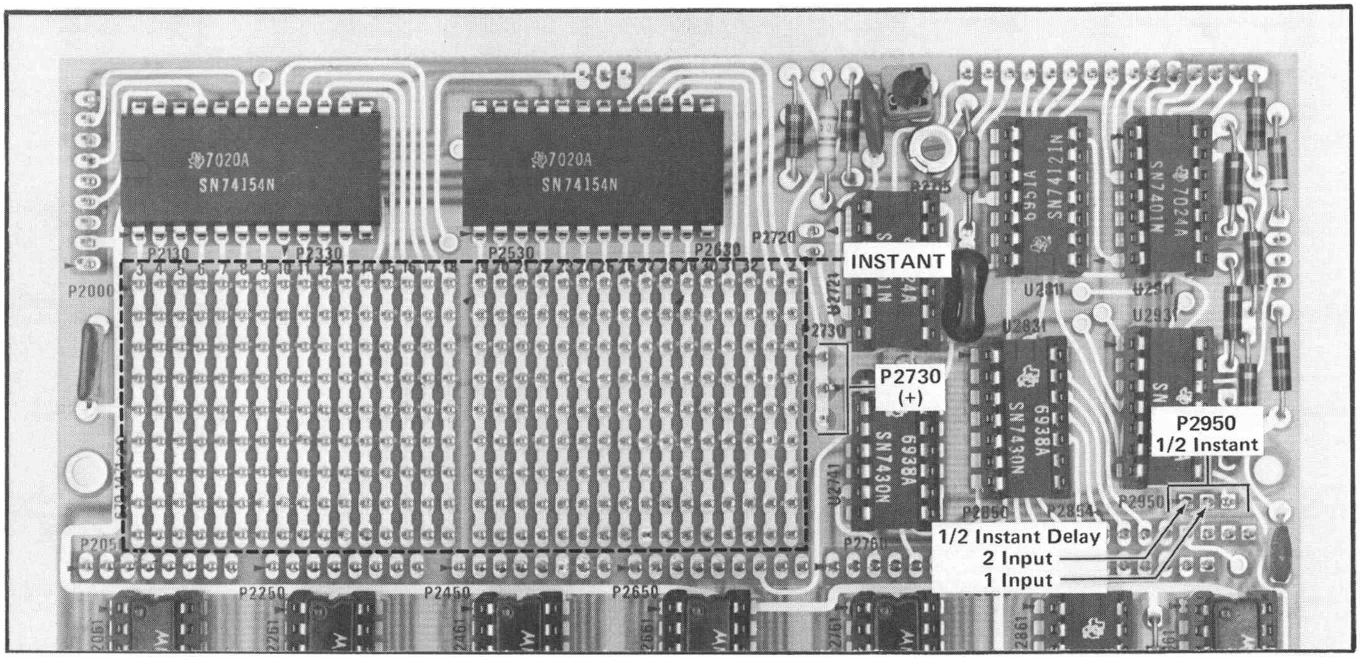


Fig. 2-8. 147 Horizontal Timing circuit board showing location of Characteristic Instants. Use with Table 2-4.

For (4) and (6), notice there is a 1/2 Instant given. In (4), locate the 9-05/0 wire and connect it to instant 14 (input to 1 μs delay). Next, connect the 9-38/0 wire to pin two of P2950; see Fig. 2-8 (output of 1 μs delay). Connection to pin two of P2950 will add 1/2 Instant or 1 μs to the count, allowing modulation to stop at 29 μs.

For (6), connect the 9-8/3 and 9-02/1 wires to instants 8 and 11 respectively (input to 1 μs delay). Next, connect the 9-36/0 wire to pin 1 of P2950 (output of 1 μs delay). This will add 1/2 Instant or 1 μs to the second and fourth starting points, starting them at 17 and 23 μs respectively.

For (9), connect the 9-45/0 wire to one of the + pins of P2730; see Fig. 2-8. This is the fifth level input, but since two levels are coming in on (6), (8) is an unused input and therefore is connected to the +.

c. Once all the above connections have been made, check that the signal appears as given in Fig. 1-2.

Removing 1/2 Instants

In the above procedure, it was shown how to program in a 1/2 Instant. Now, assume the staircase portion of the COMPOSITE signal, connections (4) and (6), are to be programmed at instants 14, 8, and 11. To stop on instant 14, disconnect the 9-38/0 wire from pin 2 of P2950 and reconnect it to the 14 instant column. To start the second step at instant 8, disconnect the 9-36/0 wire from pin 1 of P2950 and reconnect it to the instant 8 column. Disconnect the fifth level input wire from P2730 and connect it to instant 11.

Deleting Instants

Disconnect the 9-4/0 wire connected for (1) of the above example and reconnect it to P2730, +. Notice the staircase has been eliminated from the signal. Connecting any set wire to the + column will disable that particular function.

Program Sync and Burst Regeneration

Internally processed sync and burst (Gen-Locked to PROGRAM LINE IN signal) can be substituted for the PROGRAM LINE IN sync and burst before being applied to the PROGRAM LINE OUTPUT. To use internal sync and burst, change the connector on pins one and two of P4780 to pins two and three. See Fig. 2-7 for location of P4780.

IMPORTANT

Connection between pins one and two of P4780 is normal operating mode. In regeneration mode (pins two and three), all incoming VITS will be removed, including VIRS.

NOTE

If external signal input goes MONO while using internal sync and burst, the 147 automatically switches to the external sync.

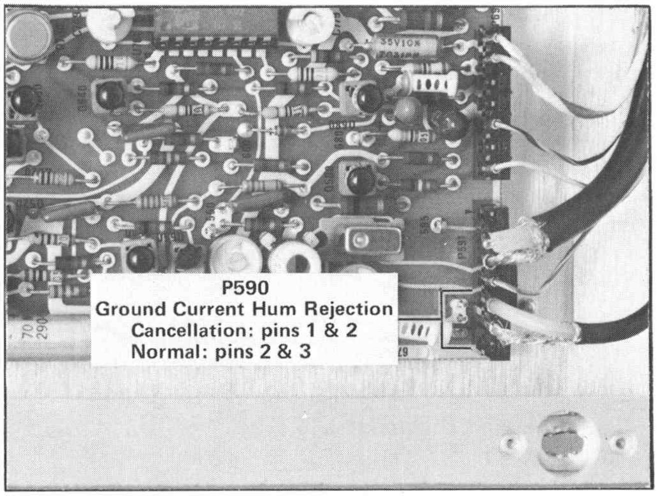


Fig. 2-9. 147 VIT Adder circuit board location of P590.

Ground Current Hum Rejection (Below SN B070528)

As shipped from the factory, the 147 has the shield (cold) side of the PROGRAM LINE IN grounded (physically and electrically). The PROGRAM LINE OUT shield is also grounded. This allows Bypass in the event of instrument malfunction, loss of power, loss of sync, etc. Should the incoming signal applied to the PROGRAM LINE IN carry hum currents at mains frequency, the 147 PROGRAM LINE IN can be modified to let the input differential amplifier of the 147 eliminate the hum. (Hum rejection of this amplifier is at least 46 dB for a 60 Hz sine-wave having a peak to peak amplitude of 3 volts or less.) However, once modified, the Bypass feature of the 147 is no longer useful as the PROGRAM LINE IN and PROGRAM LINE OUT cable shields will not have continuity and signal distortion will occur.

Ground currents originating at the signal drive source are usually due to three-phase transformer load unbalance.

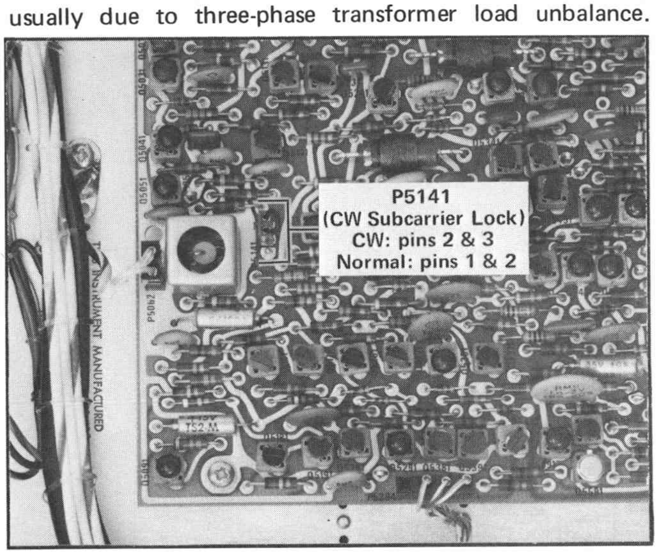


Fig. 2-10. 147 Gen-Lock circuit board showing location of P5141.

These currents, thru long lengths of ground wires can cause mains frequency voltages to appear on the shields of coaxial cables used for interconnection between instruments. Hum currents on the shields will induce hum voltages on the center conductors which in turn will produce undesired hum voltage across the load.

To eliminate the effects of the hum voltage (thereby making the Bypass feature useless) perform the following:

1. Disconnect the shorting strap on the PROGRAM LINE IN connector; the strap is located on the inner rear-panel.

2. Change the connector on pins two and three of P950, see Fig. 2-9, to pins one and two.

CW Subcarrier Lock

If desired, the 147 can be Gen-Locked to a composite sync signal with superimposte; subcarrier (such as RCA CompSync) through the BLACK BURST INPUT. This is accomplished by changing the connector on P5141, see Fig. 2-10, from pins one and two to pins two and three.

LINEARITY Modulation and Staircase Levels

The following options have been grouped, since there is interaction between them, and depending upon needed signal levels could require internal calibration.

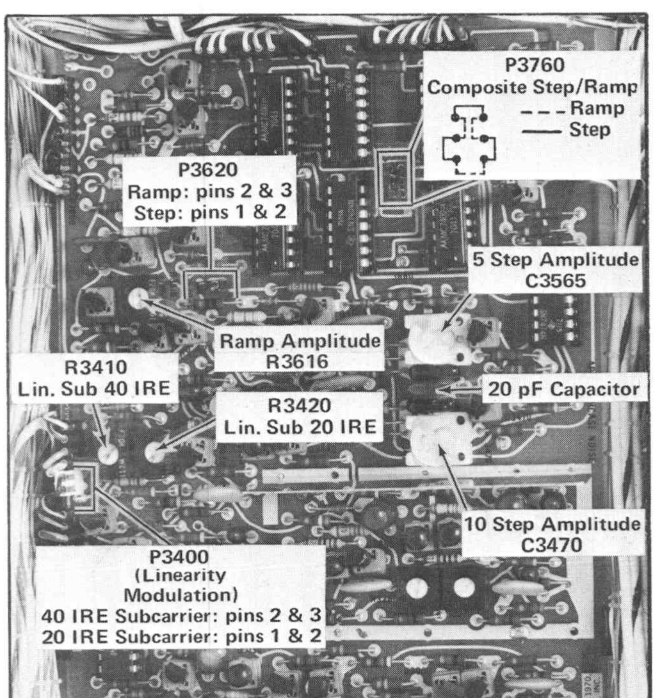


Fig. 2-11. 147 APL Staircase and Noise circuit board showing location of P3400, P3760, and adjustments.

As shipped from the factory, the LINEARITY test signal modulation amplitude is 40 IRE peak to peak. To obtain modulation of 20 IRE peak to peak, change the connector on pins two and three of P3400, see Fig. 2-11, to pins one and two.

To obtain different levels of staircase or ramp, proceed as follows:

5 STEP	Set the 147 LINEARITY switches for 5 STEPS and SUBCARRIER OFF. For a 5 Step amplitude of between 80 and 90 IRE, adjust C3565 (see Fig. 2-11) for the desired amplitude. For a 5 Step amplitude of between 90 and 100 IRE, connect the 20 pF capacitor into the socket provided (see Fig. 2-11) and adjust C3565 for the desired amplitude.
10 STEP	Set the 147 LINEARITY switches for 10 STEPS and SUBCARRIER OFF. Adjust C3470 for the desired 10 step amplitude.
RAMP	Set the 147 LINEARITY switches for RAMP and SUBCARRIER OFF. Adjust R3616 for the desired ramp amplitude.

COMPOSITE Test Signal With Ramp

Shipped from the factory, the 5 Step staircase signal is generated as a portion of the COMPOSITE signal. To replace the steps with ramp, rotate P3760, see Fig. 2-11, 180°.

NOTE

Requires horizontal reprogramming and internal adjustment.

Adjustment Procedure

a. Set the 147 LINEARITY SUBCARRIER switch OFF.

b. Using Fig. 2-8 and Table 2-4 as guides, reprogram the RAMP as follows:

Set, Instant 7 (9-8/0); Reset, Instant 14 (9-26/0).

c. Change the connector between pins one and two of P3620, see Fig. 2-11, to pins two and three.

d. Adjust Ramp Amplitude control, R3616, for 80 IRE between blanking and the ramp peak.

Modulated 12.5T/20T Sine-Squared Pulse

As factory connected, the 147 displays the modulated 12.5T Pulse. This may be changed to display the modulated 20T Pulse by reconnecting the connector on pins two and three of P6050 (see Fig. 2-12) to pins one and two.

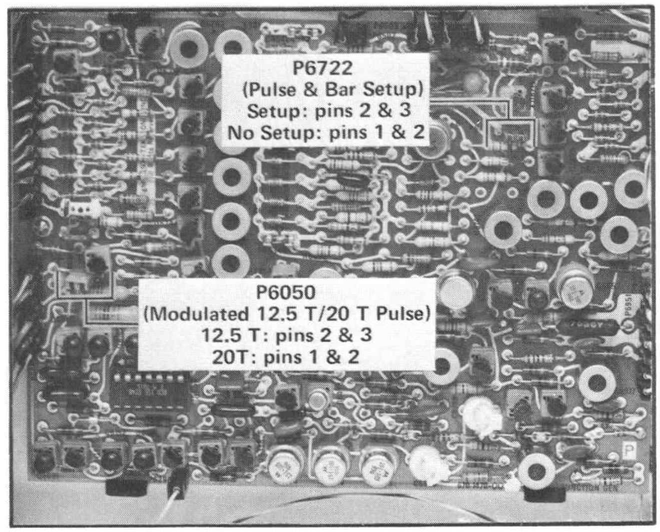


Fig. 2-12. 147 Function Generator circuit board showing location of P6050 and P6722.

NOTE

This reconnection requires internal adjustment.

Adjustment Procedure

1. Observe the SIN^2 PULSE AND BAR FULL FIELD TEST SIGNAL OUT.

2. Adjust R7661 (T Modulation Gain) and R7357 (T Luminance Gain) for (1) a peak modulation amplitude of 100 IRE and (2) the best flat bottom on the pulse at 10 IRE.

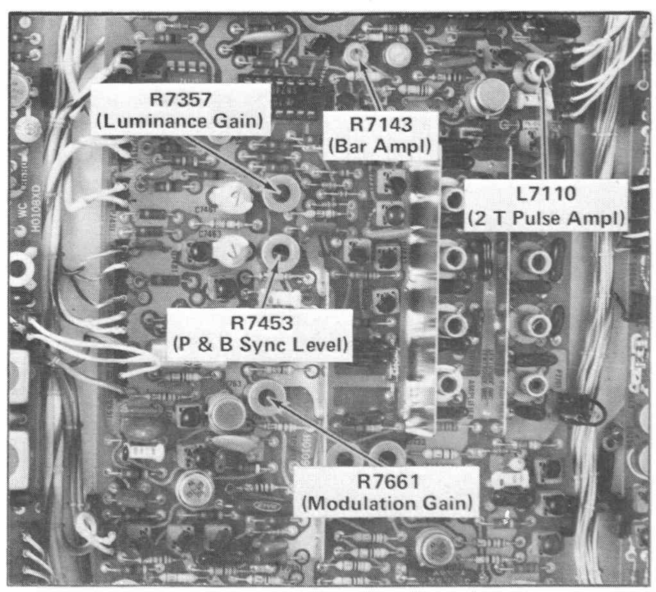


Fig. 2-13. 147 Output Amplifier circuit board adjustment locations.

Sine-Squared Pulse and Bar Setup

As factory connected, setup is not present on this signal. Setup can be obtained by changing the connector on pins one and two of P6722 (see Fig. 2-12) to pins two and three.

NOTE

This reconnection requires internal adjustments.

Adjustment Procedure

1. Observe the SIN^2 PULSE AND BAR FULL FIELD OUTPUT signal.

2. Adjust L7110 (2T Pulse Amplitude), see Fig. 2-13, for a peak pulse amplitude of 100 IRE.

3. Adjust R7143 (Bar Amplitude) for a peak bar amplitude of 100 IRE.

4. Adjust R7357 (Luminance Gain) for equal amounts of chrominance above the 100 IRE level and below the setup level (10 IRE).

5. Adjust R7453 (P & B Sync Level) until the luminance level is aligned with the blanking level.

6. Adjust R7661 (Modulation Gain) until the peak of chrominance within the modulated pulse is at 100 IRE and the bottom portion of chrominance within the modulated pulse is flat at 10 IRE.

7. Adjust R8630 (Burst Amplitude), see Fig. 2-14, for a burst amplitude of 40 IRE peak to peak.

8. Observe VIRS. (Programmed on line 20 of either field.)

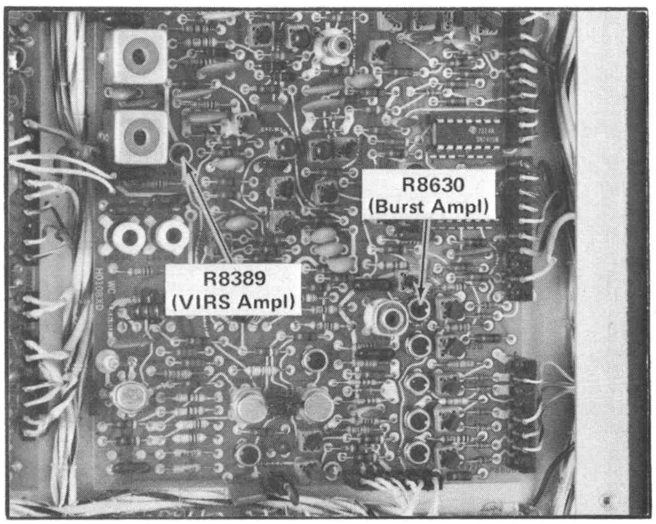


Fig. 2-14. 147 Modulator circuit board adjustment locations.

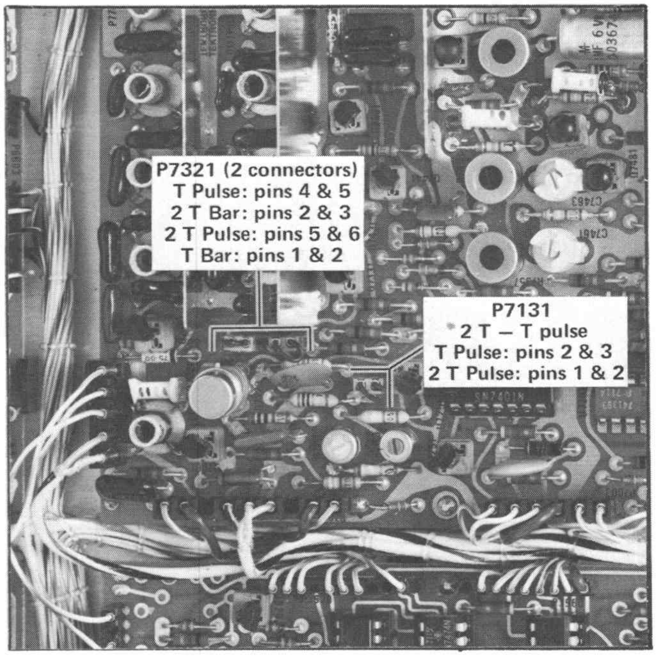


Fig. 2-15. 147 Output Amplifier circuit board showing locations of P7131 and P7321.

9. Adjust R8380 (VIRS Amplitude) for a VIRS subcarrier amplitude of 40 IRE peak to peak.

10. Observe the LINEARITY test signal with modulation.

11. Adjust R3420 (40 IRE Modulation Amplitude), see Fig. 2-11, for a modulation amplitude of 40 IRE peak to peak.

12. Change the connector on pins two and three of P3400 to pins one and two.

13. Adjust R3410 (20 IRE Modulation Amplitude) for a modulation amplitude of 20 IRE peak to peak.

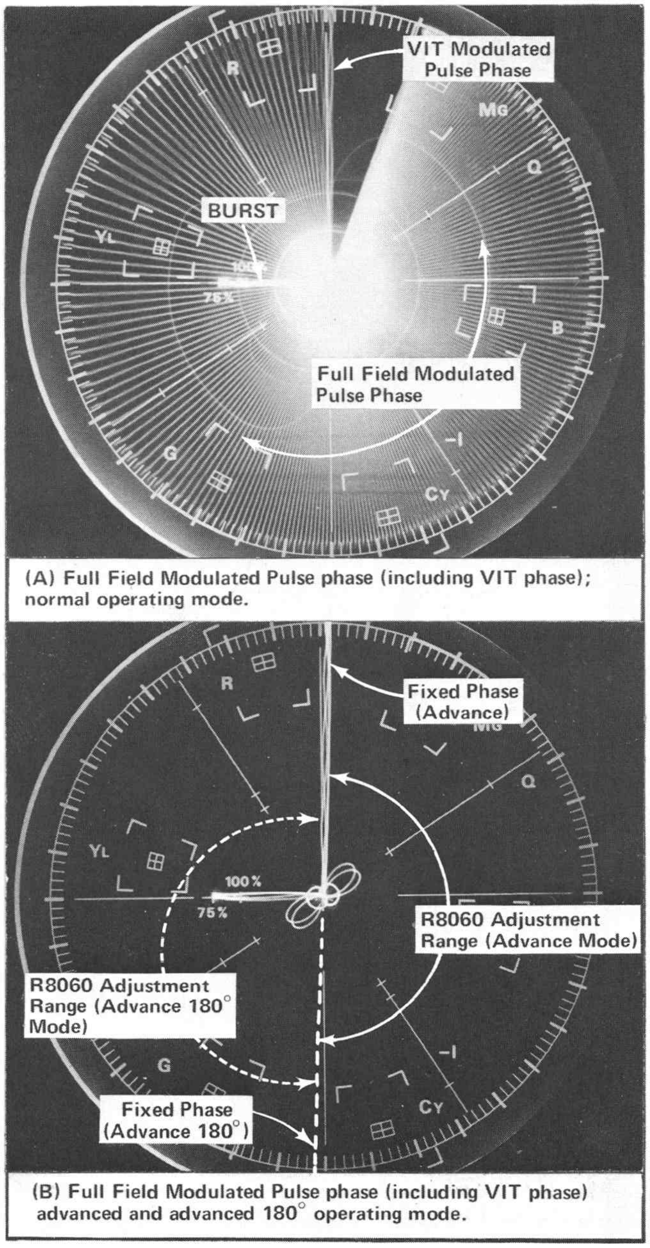
14. Change the connector on pins one and two of P3400 back to pins two and three.

2T/T Sine-Squared Pulse

As factory connected, the 147 displays the 2T Pulse. To display the T Pulse in place of the 2T Pulse (1) change the connector on pins one and two of P7131 (see Fig. 2-15) to pins two and three, and (2) change the connector on pins five and six of P7321 to pins four and five.

T/2T Step Bar (Integrated Sine-Squared Pulse)

As factory connected, the 147 displays the T Step Bar. To display the 2T Step Bar in place of the T Step Bar, change the connector on pins one and two of P7321 to pins two and three.



(A) Full Field Modulated Pulse phase (including VIT phase); normal operating mode.

(B) Full Field Modulated Pulse phase (including VIT phase) advanced and advanced 180° operating mode.

Fig. 2-16. Typical Vectorscope display of the Modulated pulse phase in (A) Normal Mode and (B) Advanced Mode.

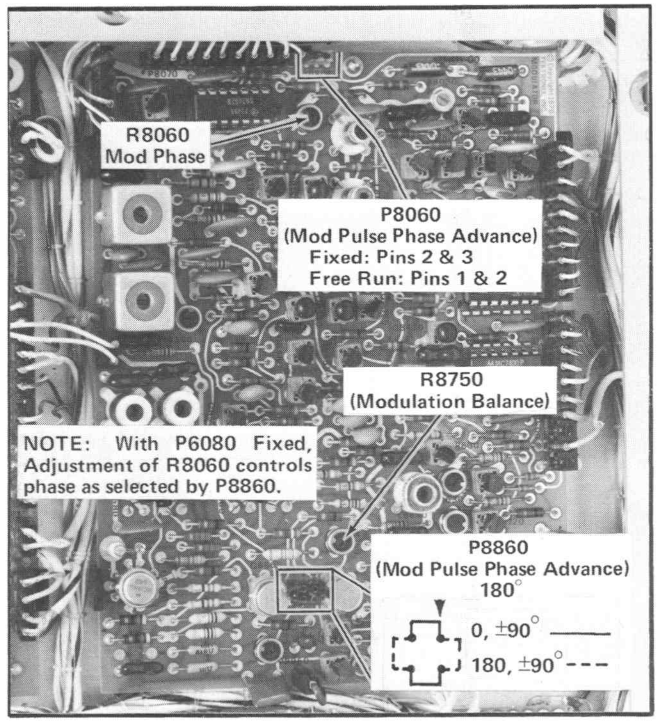


Fig. 2-17. 147 Modulator circuit board showing location of P8060, P8860, and adjustments.

Modulated Sine-Squared Pulse Phase Advance/ Advance 180°

The following changes have been grouped because of interaction.

Phase Advance. As factory connected, the phase of the Full Field Modulated Sine-Squared Pulse is not fixed. This can be demonstrated by observing the 147 FULL FIELD SIN^2 PULSE AND BAR test signal on a vectorscope. A fan-shaped display, as shown in Fig. 2-16A, will be observed. This enables the test signal to be used where measurement accuracy is of prime importance.

By changing the connector on pins one and two of P8060, see Fig. 2-17, to pins two and three, the phase of the Full Field Modulated Sine-Squared Pulse will be fixed. This is shown in Fig. 2-16B.

Once Phase Advance has been established, adjustment of R8060 (Mod Phase) can be used to vary the fixed phase approximately 180°.

NOTE

In the Phase Advance mode, the Full Field and VIT Modulated Sine-Squared Pulse have the same phase. This allows source coding of the VIT.

Advance 180°. As discussed above, it is possible to obtain Phase Advance of the Modulated Sine-Square Pulse during VIT. If needed, the phase can be changed 180° from that obtained with adjustment of R8060 by rotating the connector on P8860 (see Fig. 2-17) 90°. This provides a 360° control range of the VIT phase.

NOTE

The Phase of the Full Field signal will also be advanced 180° in this mode.

This connection requires internal adjustment.

Adjustment Procedure

1. Observe the COMPOSITE FULL FIELD TEST SIGNAL OUT.

2. Adjust R8750 (Modulation Balance), see Fig. 2-17, for minimum modulation on the blanking level.

OPTION 01

The 147 can be programmed in compliance with FCC Rules and Regulations § 73.676 (f) for Remote Control Monitoring.

Fig. 2-18 shows the three signals stipulated in § 73.676. The 147 will generate the Multiburst and Composite Test Signals, but the Color Bar Test Signal must be externally applied to the 147. (A Tektronix Type 140 NTSC Test Signal Generator will provide the required Color Bar signal.)

As shipped from the factory with Option 01, the 147 will be VIT programmed as follows (see Fig. 2-6 for VIT Line and Field Selector Plugs):

VIRS--Field 1, line 20 (blue connector).

NOISE--Field 2, line 20 (green connector).

MULTIBURST--Field 1, line 18 (yellow connector).

COMPOSITE--Field 1 and 2, line 19 (orange connector).

SPARE 2--Field 1, line set to OFF (red connector); P4810, pins 2 and 3.

SPARE 1--Field 2, line 18 (brown connector); P4820, pins 1 and 2.

In addition to the VIT programming, the following changes have been made.

a. Pin 21 of P9014 (REMOTE) has been disconnected (see Fig. 2-2). This prevents internal VIRS from being displayed. To display VIRS, connect pin 21 as shown in Fig. 2-2.

b. The 2T Bar will be displayed in place of the T Bar. See T/2T Bar in the Operating Changes portion of this section for details.

c. The 10 Step LINEARITY signal has been set such that each riser is 10 IRE in place of the normal 9 IRE with the last level at 100 IRE rather than 90 IRE. See Linearity Modulation in the Operating Changes portion of this section for details.

d. The second and last burst frequencies of the MULTIBURST signal have been changed such that they are 1.25 MHz and 4.1 MHz. See the calibration procedure of this manual for adjustment procedure.

e. The 12.5 VIT Phase (Field 1 and 2, line 19) has been set to correspond to Magenta (this corresponds to approximately 62° from 0° on a vectorscope). To accomplish this, P8860 (Mod Pulse Phase Advance), see Fig. 2-17, is connected in the 0, ±90° position and adjusted by R8060 (Mod Phase).

Operation of the 147 with Option 01 is identical with that given in the First Time Operating Instructions except, (1) the MULTIBURST AMPLITUDE switch must be set to REDUCE, (2) an external color bar VIT on Line 18 of Field 2 must be applied to the 147 rear-panel EXT VITS IN, and (3) the NOISE switch should be set to INSERTION (1/2 Line).

GLOSSARY OF TERMS

ACTIVE VIDEO LINES: All video lines not occurring in the vertical blanking interval.

APL: Average picture level. The average signal level, with respect to blanking level, during active picture scanning time, expressed as a percentage of the difference between the blanking and reference white levels.

BACK PORCH: That portion of the composite video signal which lies between the trailing edge of the horizontal sync pulse and the trailing edge of the horizontal blanking pulse.

BLACK BURST: A signal consisting of composite sync and burst. Normally has setup.

BLANKING LEVEL: The level of the front and back porches of the composite video signal. Normally at 0 IRE.

BREEZEWAY: In NTSC color, the portion of the back porch between the trailing edge of the sync pulse and the start of the color burst.

BURST FLAG: Pulses used to key out a portion of the 3.579545 MHz sine wave subcarrier for use as a reference for the color signal.

CHROMINANCE: That property of light which produces a sensation of color in the human eye apart from any variation in luminance that may be present.

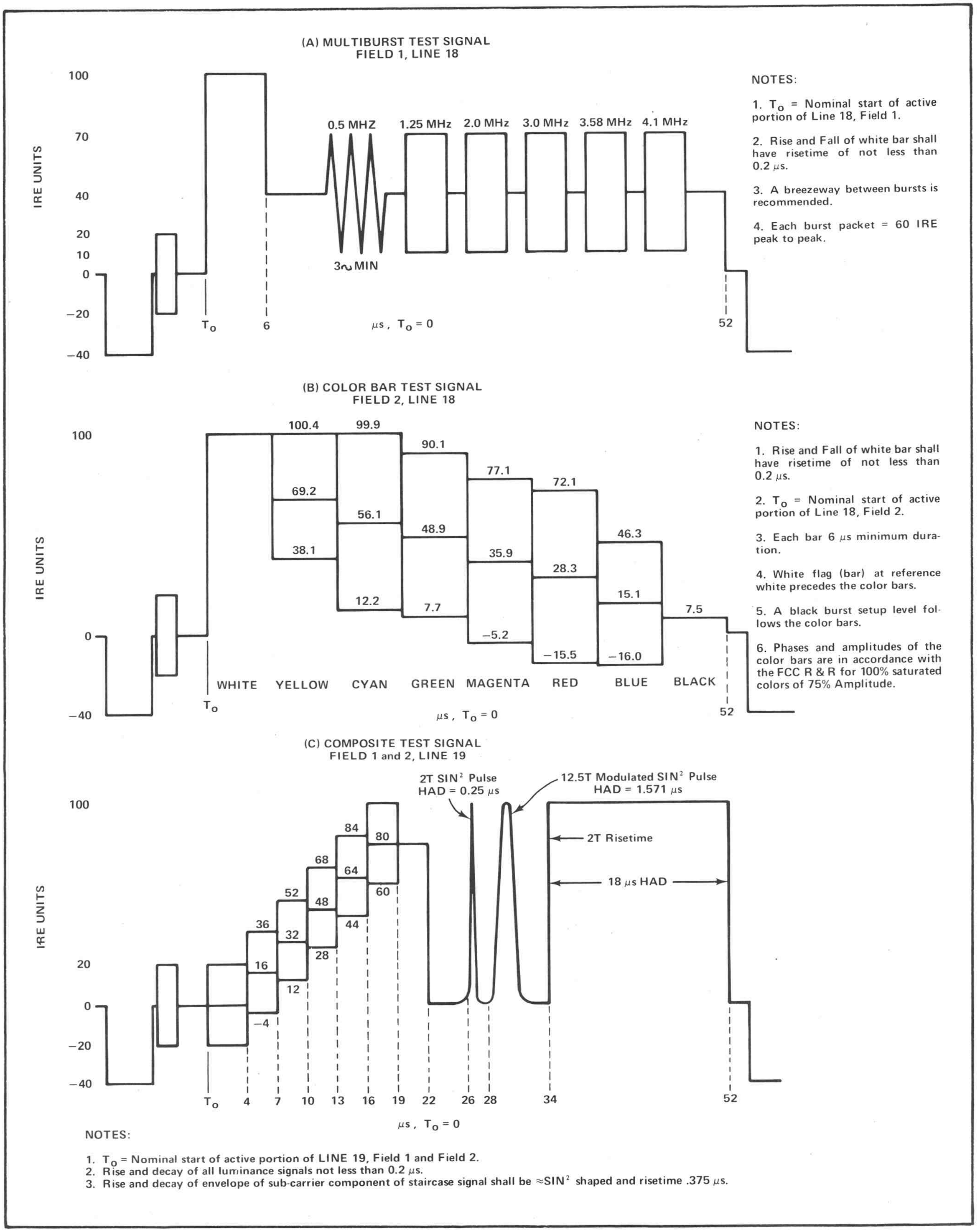


Fig. 2-18. Test signals to be generated and inserted in the vertical interval for Remote Control Monitoring. Reference: FCC Rules and Regulations, Section § 75.676 (f) Figures 13, 14, and 15 of Section § 73.699; ammended Part 73 of the Rules and Regulations, October 5, 1971.

COLOR BAR: A test signal, typically containing eight basic colors: white, yellow, cyan, green, magenta, red, blue, and black, which is used to check the chrominance functions of color TV systems.

COLOR BURST: In NTSC color systems, this normally refers to a burst of approximately 8 to 10 cycles of 3.579545 MHz subcarrier frequency on the back porch of the composite video signal. This serves as a color synchronizing signal to establish a frequency and phase reference for the chrominance signal.

COLOR SUBCARRIER: In color systems, this is the carrier signal whose modulation sidebands are added to the monochrome signals to convey color information; in NTSC, it is a 3.579545 MHz sine wave.

COMPOSITE BLANKING: This signal is composed of pulses at line and field frequencies used to make the return traces of a picture tube invisible.

COMPOSITE SYNC: The line and field rate synchronizing pulses (including the field equalizing pulses) when combined together form the composite sync signal.

COMPOSITE VIDEO: For color, this consists of blanking, field and line synchronizing signals, color synchronizing signals, chrominance and luminance picture information. These are all combined to form the complete color video signal.

DIFFERENTIAL GAIN: The difference between (1) the ratio of the output amplitude of a small, high-frequency sine-wave signal at two stated levels of a low frequency signal on which it is superimposed and (2) unity.

DIFFERENTIAL PHASE: The difference in output phase of a small high-frequency sine-wave signal at two stated levels of a low-frequency signal on which it is superimposed.

EIA: An abbreviation for Electronic Industries Association.

EQUALIZING PULSES: Pulses of one half the width of the horizontal sync pulses which are transmitted at twice the rate of the horizontal sync pulses during the portions of the vertical blanking interval immediately preceding and following the vertical sync pulses. The purpose of these pulses is to cause the vertical deflection to start at the same time in each interval, and also serves to keep the horizontal sweep circuits in step during the portions of the vertical blanking interval immediately preceding and following the vertical sync pulse.

FIELD: One half of a complete picture (or frame) interval, containing all of the odd, or all of the even, lines of the picture.

FIELD BLANKING: Refers to the blanking signals which occur at the end of each field. Also called vertical blanking.

FIELD FREQUENCY: The rate at which one complete field is scanned, normally 59.94 times a second in NTSC.

FRAME: One complete picture consisting of two fields of interlaced scanning lines.

FRONT PORCH: That portion of the composite picture signal which lies between the leading edge of the horizontal blanking pulse and the leading edge of the corresponding sync pulse. Normally 1.59 μs.

GEN LOCK: Subcarrier to burst lock.

H RATE: The time for scanning one complete line, including trace and retrace. NTSC equals 1/15734 second (color) or 63.56 μs.

IRE: An abbreviation for Institute of Radio Engineers.

IRE SCALE: An oscilloscope scale that applies to composite video levels. There are 140 IRE units in 1 volt.

LINE BLANKING: The blanking signal at the end of each scanning line. Used to make the horizontal retrace invisible. Also called horizontal blanking.

LINE FREQUENCY: The number of horizontal scans per second, normally 15,734.26 times per second in NTSC.

LUMINANCE (Y): The amount of light intensity, which is perceived by the eye as brightness (referred to as 'Y').

NTSC: National Television Systems Committee. An industry-wide engineering group which, during 1950-1953, developed the color television specifications now established in the United States.

REFERENCE WHITE LEVEL: The level corresponding to the specified maximum excursion of the luminance signal in the white direction.

SETUP: The separation in level between blanking and reference black levels. Normally 7.5 IRE.

STAIRCASE: A video test signal containing several steps at increasing luminance levels. The staircase signal is usually amplitude modulated by the subcarrier frequency and is useful for checking amplitude and phase linearities in video systems.

SYNC: An abbreviation for the words 'synchronization', 'synchronizing'. etc. Applies to the synchronization signals, or timing pulses, which lock the electron beam of the picture monitors in step, both horizontally and vertically, with the electron beam of the pickup tube. The color sync signal (NTSC) is known as the color burst.

VERTICAL BLANKING INTERVAL: The blanking portion at the beginning of each field. It contains the equalizing pulse, the vertical sync pulses, and VITS (if desired). Presently 18-21 lines duration.

VERTICAL DRIVE: A pulse at field rate used in TV cameras. Its leading edge is coincident with the leading edge of the vertical blanking pulse and its duration may be 10.5 lines.

VIRS: Vertical Interval Reference Signal. A reference signal proposed by the B.T.S. for use on line 20.

VITS: Vertical interval test signal. A signal which may be included during the vertical blanking interval to permit inservice testing and adjustment of video transmission.

SECTION 3
CIRCUIT DESCRIPTION

General

This section of the manual describes the electrical operation of circuits within the 147 using a "block" rather than a "part" description. The description is keyed to the individual diagrams and a master block diagram given on separate pull-out pages in the Diagrams Section of this manual. Each block described will be clearly shown in these diagrams. Where new or unusual circuitry has been used or where additional detail is necessary, it will be fully explained.

The 147 can be considered as in Fig. 3-1. Basically, the 147 consists of (1) a Relay to provide bypass in the event of loss of sync, instrument malfunction, etc., (2) Sync and Subcarrier processing circuits to detect synchronization information, (3) Timing circuits to provide gate signals used for generation of the output signals, (4) Test Signal Generator to generate the various output signals (NOISE is independent, and is generated at all times), (5) Program Control Switching to allow the operator to select the mode of operation, (6) Electronic Switches to route all signals to the proper outputs at the proper time, and (7) Output Amplifiers to provide sufficient current to drive the outputs.

Diagram ⟨0⟩ a & b

The PROGRAM LINE IN signal is applied to a relay which (1) bypasses the program signal through a delay that matches the electronic circuitry to the PROGRAM LINE OUT in the event of circuit failure, loss of power, etc., or (2) applies the program signal to the active circuits of the 147 for futher processing.

Gain: This AC coupled stage provides either unity gain of the program signal or variable (front-panel controlled) gain of the program signal.

Clamp Pulse Generator: This circuit, driven by re-processed composite sync, generates a pulse which corresponds to the time of back porch.

Clamp: This circuit clamps the program signal to 0 volts during back porch time. This DC restores the program signal and provides the correct levels to the VIT switches.

VIT Switches: U761 and U861 are used to route the program signal to the Output Amplifiers except when VITS are inserted during the vertical interval. During VITS insertion, the switches route the internally generated Full Field signals to the Output Amplifiers as programmed VITS.

Diode Switch: This stage allows DC control of the VIT Switches dependent upon the mode of operation selected from the front-panel, or by remote means.

Output Amplifiers: The amplifiers convert the double-ended VIT Switch outputs into single-ended outputs and provide the low impedance necessary to drive the PROGRAM LINE OUT, PROGRAM MONITOR OUT, and PREVIEW MONITOR OUTPUTS.

Diagram ⟨1⟩

The Vertical and Horizontal Counters are used to time the various gating signals required for the forming of the test signals generated by the 147.

Horizontal Integrator: This stage produces a ramp corresponding to the leading edges of each horizontal sync pulse. The DC level obtained by the ramp at the time of sample is then used to control the 1 MHz Osc.

Phase Detector: This stage acts as a gate, opening one time each active line, and allows the signal DC level from the Horizontal Integrator to control the 1 MHz Osc.

1 MHz Osc: The oscillator generates the 1 MHz pulses required to clock the Divide-By-64 Counter. The output of the oscillator consists of positive going pulses (limited sinewaves).

Divide-By-64 Counter: This stage divides the 1 MHz by 64, from which the Phase Detector gate and 1 μs pulses used to time various test signals can be derived. The counters are level sensitive (positive) and clocked at a 1 MHz rate.

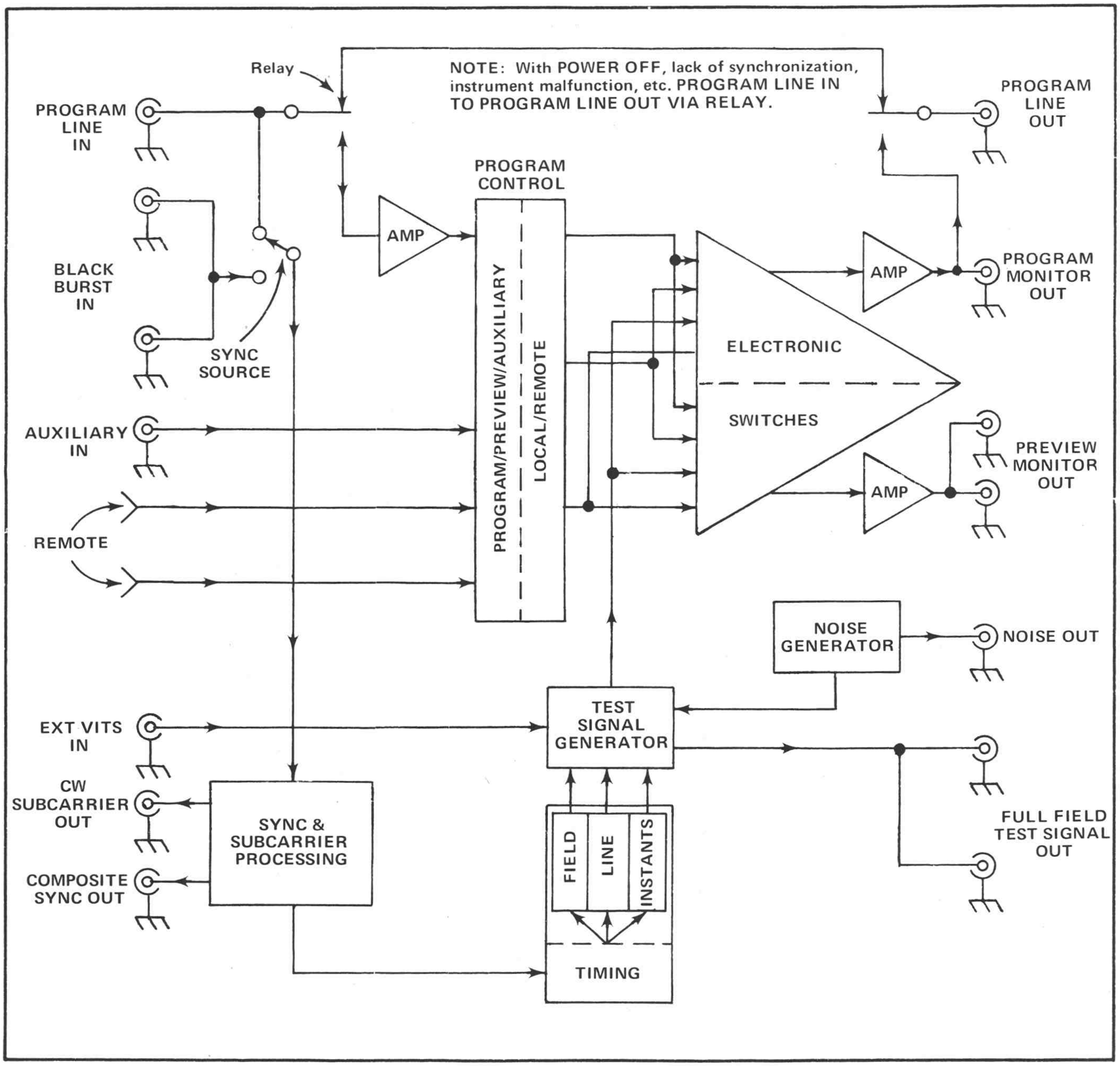


Fig. 3-1. Basic block diagram of the 147.

Delay: The Delay circuit allows the operator to change the timing of the internally generated signals with respect to the incoming sync by delaying the pulse coming from the Divide-By-64 Counter. The output of this stage is then used to gate the Phase Detector one time each line.

H Blanking: This stage combines the various signals from the Divide-by-64 Counter into the required horizontal blanking timing that is used to gate (switch) the VIT signals into the program signal during VIT time.

Vertical Integrator: This stage is used to provide a pulse on the last vertical serration pulse of each field. This pulse is used to (1) preset the Divide-By-525 Counter, (2) drive the Field Recognition stage, and (3) enable VITS.

Field Recognition: This circuitry provides the field pulses necessary to place the VIT signals on the proper field, as well as all other field timing information required for the Full Field signals. The stage is driven by the Divide-By-64 Counter and the Vertical Integrator, which are coincident every other field.

Clock: This stage is driven by pulses corresponding to instants 15 and 31 (see Operating Instructions for details). These instants are directly related to the external sync, since they are derived by the Divide-By-64 Counter.

Divide-By-525 Counter: The counter generates the various timing gates required for a one-half line offset used in interlace scanning. The counter is initially set to a count of 499 by a pulse obtained in the Vertical Integrator. It is then toggled from the Clock stage, counting to 1024 in a divide-by-2, divide-by-4,. . . . ., divide-by-1024 sequence. On the 1024 count, the counter is reset to a count of 499 and the sequence is repeated. However, only the initial preset of the counter is from the Vertical Integrator as the counter is self-setting. (1024 −499 = 525.)

Matrix: The matrices are used to combine the various gates from the Vertical Counter into timing pulses corresponding to Vertical Blanking, Field Square Wave, Window, and the 9 Line Keyout.

Diagram ⟨2⟩ a & b

The Horizontal Timing combines the various gate signals generated by the Vertical and Horizontal Counters to form the timing information required to form the various signals generated by the 147.

Instant Decoder: This stage decodes the Divide-By-64 Counter outputs into 32 outputs approximately 2 μs apart, each output having a 1 μs negative going pulse once each active line. Each horizontal timing signal can be programmed by the operator such that internally generated signals can be time positioned as desired.

Set/Resets: The Set/Resets provide the timing signals as programmed for generation of the output signals.

Staircase Logic: This stage arranges the timing information into a matrix for the various LINEARITY test signals.

Pulse Generator Logic: This stage combines the timing signals necessary for the pulse of the SIN^2 PULSE AND BAR or COMPOSITE test signal.

20T Timing Logic: This stage provides the timing pulses required for the modulated sine-squared pulse.

Bar Generator Logic: This stage provides the switching pulse for the bar of either the SIN^2 PULSE AND BAR or COMPOSITE test signal.

MB Width: This stage combines the various output signals to time the MULTIBURST test signal and sets the width of each burst.

Diagram ⟨3⟩ a & b

The Noise Generator generates the NOISE test signal. This is shown on diagram 3a. The APL & Staircase (see diagram 3b) is used to generate the LINEARITY and FLAT FIELD test signals.

Noise Generator: This stage uses the thermal characteristics of two resistors and one transistor (R3285, R3385, and Q3370) to generate the noise.

Noise Amplifier: This high gain amplifier amplifies the noise signal for use by the Noise Amplitude Switching circuit.

Noise Amplitude Switching: The stage consists of balanced amplifiers which have front-panel gain controls (NOISE LEVEL dB). In addition, the amplifiers provide sufficient current to drive the NOISE OUTPUT.

Field Square Wave: The stage consists of a multivibrator and current switch. The multi is used to shift the Field Square Wave so that it ends coincident with the end of a line rather than at the center of the line. This is because the Field Square Wave is obtained from the Divide-By-525 Counter, which is operating at a one-half line rate. The output of the multi then controls the current switch. The current is switched into the output amplifier to obtain the pedestal amplitude of the FIELD SQUARE WAVE test signal.

Window: This stage is identical to that of the Field Square Wave, except the output of the multi controls the Window Logic stage (see discussion with diagram 4B) rather than controlling a current switch.

Bounce Rate Generator: This circuitry consists of a modified Bowes Oscillator which is front-panel controlled (RATE). This allows the oscillator frequency to be changed from 1 to 10 seconds. The output is then used to control the Bounce Current Generator.

Bounce Current Generator: This stage consists of three current switches to set the level of the FLAT FIELD test signal. Referring to diagram 3b, Q3825 supplies the 10% current, Q3820 supplies the 90% current and Q3720 supplies the current for the VARIABLE. The diodes located in the collector circuit of each current source

switch the current on or off; the diodes in the emitters control the switching between 10%, 90%, and variable APL.

Staircase Modulation: This stage consists of a programmable current switch to provide sufficient current to the modulator for either the 20 or 40 IRE subcarrier modulation on the LINEARITY test signal.

Staircase Switch Logic: This stage combines the various timing and gate signals which are then used by the Staircase Generator.

Staircase Generator: The stage consists of a Miller Integrator, Reset, 10 step current switch, 5 step current switch, and a ramp current switch, which are used to produce the LINEARITY test signal.

Referring to diagram 3b, C3441 and C3443 are the Miller feedback capacitors. Q3540 is the reset. For 10 Step Staircase, the charge on C3461 is transferred to the Miller to produce the step. For 5 Step Staircase, the charge on C3473 (twice that of C3461) is transferred to the Miller. For the Ramp, the current through R3461 is transferred into the Miller to produce the normal ramp expected of a Miller. The output of the stage is then applied to the Luminance Amplifier for further processing.

Diagram ⟨4⟩

The VIT and Full Field Logic circuitry is used to allow programming of the VIT signals, matrix all timing used to produce the test signal outputs, and controls the indicator lamps.

Sync Reset: This circuit prevents any VIT signals from being inserted into the vertical interval should loss of vertical sync occur.

Divide-By-16 Counter: The counter generates gate signals for use in the Decoder. The counter is toggled each active line corresponding to instant 0, and produces the required gate signals to drive the Decoder.

Decoder: The Decoder provides one output per line, which corresponds to one line of the vertical interval for lines 10 through 21.

Matrix: This stage allows programming of the various VIT signals.

Modified Vertical Blanking: The circuit shifts the vertical blanking signal so that it ends on line 22. This inhibits the first and last half of line 21 from being generated during Full Field signals.

VIT Spare: This circuitry allows programming 2 of 3 signals. (Refer to the Operating Instructions for details.) It also allows the use of 6 programming lines for 7 different VIT signals.

VIT "OR": This stage senses VIT logic and passes it to the VIT & Aux Switch stage.

VIT & Aux Switch: This stage (1) switches the Diode Gate (see diagram 0 b) if VIT logic is present via the VIT "OR", allowing the VIT signals to be inserted on the program signal, (2) should loss of sync occur, the PROGRAM LINE IN is bypassed to the PROGRAM LINE OUT, it will sense the loss and allow sync and burst only to be gated onto the MONITOR OUTPUTS, or (3) in Auxiliary, sync and burst will be gated into the auxiliary signals.

Logic: The remaining stages on diagram 4 are used for combining the VIT and Full Field gate signals into timing pulses which are then used in the generation of the various test signals.

Diagram ⟨5⟩ a, b, & c

The Gen-Lock circuitry is used to (1) provide reprocessed composite sync and (2) lock the internal 3.58 MHz to the incoming burst signal.

Sync Strip: The stage separates the composite sync from the program signal (or black burst input) and reprocesses the sync for use in the 147. Reprocessing of composite sync eliminates 60 Hz hum, line sync tilt, etc.

Back Porch Gate Generator: The generator, driven by reprocessed composite sync, provides a pulse corresponding to the time of back porch or the time of line sync and back porch. This pulse is then used to control the Quad Demodulators.

AGC Chroma Amplifier: The circuit picks the 3.58 MHz components from the program signal (or black burst input). The 3.58 MHz components are then AGC'd and amplified for use in the Quad Demodulator stage.

Quadrature Demodulators: The demodulators, driven by the Back Porch Gate Generator, AGC Chroma Amplifier,

and the internal 3.58 MHz, produces output pulses which are in direct relation to the phase and amplitude of the externally applied 3.58 MHz vs. the internal 3.58 MHz. The output pulses are then used in the Frequency Control Stage.

Frequency Control: This stage (1) provides an AGC current to control the overall gain of the AGC Chroma Amplifier and (2) switches the control of the internal 3.58 MHz Oscillator from a free run (internal) to a locked mode which is dependent upon the phase of the program signal burst.

3.58 MHz Oscillator: The 3.58 MHz crystal controlled oscillator generates the subcarrier used by the 147. In the free-running mode, the frequency will be within 25 Hz of 3.579545 MHz. In the locked mode, the frequency will be locked to the incoming program burst. The output is amplitude limited and applied to the Subcarrier Output Amplifier (see discussion of diagram 9) for further processing.

Diagram ⟨6⟩ a & b

The Function Generator consists of diagram 6a and the Diode Shaper shown on diagram 6b. Its function is to generate triangle pulses which (1) correspond to the multiburst frequencies or (2) correspond to the sine-squared pulse. The triangle pulses are then shaped into sine-waves, thus forming the multiburst frequencies and sine-squared pulse.

Triangle Generator: This stage, consisting of a Miller Integrator, is used to produce the triangle pulses (e.g., positive and negative ramps with the rate of rise and fall equal). Current into or out of the Miller capacitor, supplied by Q6266 (I) and Q6164 (2I), determine the rate of the ramp; hence, the frequency.

Triangle Level Detector: This stage senses the upper and lower limits of the generated ramp via the Triangle Generator to change the direction of the ramp being produced.

Current Switch: This stage, controlled by the Level Detector, supplies the current necessary to change the direction of the ramp being produced via the Current Inverter stage.

Current Inverter: This stage (1) supplies current to the Miller capacitor for a ramp in one direction, or (2) when current via the Current Switch is available, routes one-half the current from Q6164 away from the Miller capacitor to change the direction of the ramp.

Rate Control: This stage consists of several current switches (one switch for each burst and sine-squared pulse) which provide the necessary current at the correct time to determine the ramp rate. The amount of current from each switch sets the rate at which the ramp rises and falls; hence, determines the frequency of the sine-waves out of the Diode Shaper.

Stop Level: This stage controls the resting point of the ramp, during which no ramp is allowed to be generated.

Stop Control: This stage controls the Miller, either allowing a ramp to be generated, or stopping the ramp at a level determined by the Stop Level Stage.

Diode Shaper: This circuit shapes the triangle pulses from the Triangle Generator into the required sine waves for use as multiburst frequencies or the sine-squared pulse.

Amplifier: The amplifier provides sufficient sine-wave current to drive the 20T Switch and Modulation stages.

Noise Pedestal: This circuit supplies the current to set the pedestal level of the NOISE test signal. This stage is controlled by the front-panel NOISE and PEDESTAL switches.

Setup: This stage supplies the current to provide the SIN^2 PULSE AND BAR test signal with setup.

MB Pedestal: This circuit supplies the current necessary to set the multiburst luminance levels.

Diagram ⟨7⟩ a & b

Pulse Generator: This stage generates a narrow pulse which is shaped by the T or 2T Filter into the T or 2T Pulse.

Bar Generator: This circuit consists of a current switch to provide sufficient current to produce 100 IRE.

T/2T Filters: The filters are used to form the various signals applied.

20T Switch: This stage, during modulated sine-squared pulse time, allows the current corresponding to the 20T (or 12.5T) pulse luminance to pass from the Delay. During multiburst time, the switch puts a DC current through the

Delay to prevent multiburst from being passed to the Luminance Amplifier.

Delay: The delay circuit is used to match the delay of the modulator.

Luminance Amplifier: The amplifier sets the amplitude and provides sufficient current for the luminance portion of the signals to drive the 147 FULL FIELD OUTPUTS.

Noise Switch: The Noise Switch prevents any noise being applied to the FULL FIELD OUTPUTS or VIT Adder, except when noise has been selected as the output.

MB Gain: This stage sets the amplitude of the multiburst, either NORMAL or REDUCED, and is front-panel controlled. The output is then applied to the Chrominance Amplifier.

Chrominance Amplifier: The amplifier sets the amplitude and provides sufficient current for the chrominance portion of the signals to drive the 147 FULL FIELD OUTPUTS and VIT Inserter.

Add: This stage combines the luminance portion of the signals from the Luminance Amplifier and the chrominance portion of the signals from the Chrominance Amplifier. This forms the composite test signals available at the FULL FIELD OUTPUTS and VIT Inserter.

Ext VIT Amplifier: This stage amplifies the externally applied VIT signal to the correct level to drive the VIT Inserter.

Variable Gain: This stage sets the amplitude of the signals from the Ext VIT Amplifier.

VIT Level Corrector: This stage samples the back porch of the external VIT signal. If other than 0 volts, a correction voltage will be developed and applied to the Ext VIT Amplifier to return the back porch level to 0 volts.

Diagram ⟨8⟩ a & b

VIRS Detector: This stage is used to detect any incoming VIR signal. Basically, it detects (1) whether chrominance is on the first portion of a line for the approximate time required and (2) detects that chrominance is not present on the second half of the line.

AGC: This stage AGC's the internal 3.58 MHz from the Fixed or Field Variable Phase stages and applies it to the Modulator.

Fixed Phase: This stage (front-panel controlled) determines the phase of the internal subcarrier applied to the Modulator.

Field Variable Phase: This stage changes the phase of the internal subcarrier applied to the modulator such that the modulation phase is changed each line of a field.

Switch: This stage allows switching between Fixed and Field Variable Phase of the subcarrier applied to the Modulator. As an example, the modulation on the 5 Step portion of the COMPOSITE test signal is fixed; the phase of the modulation on the modulated sine-squared pulse is variable.

Keyout: This stage keys off the modulator when the FULL FIELD NOISE or NOISE VIT signal is desired. This ensures no unbalance of the modulator.

VIRS Mod Amp: This stage sets the amplitude of the VIRS modulation, which is then applied to the 1 μs filter for shaping.

Burst Timing: This stage times the burst signal such that it is generated at the proper time. The output is applied to the 375 ns filter for shaping.

Sync Regen Amplifier: This stage is a current source for the regenerated sync signal. The amplitude is set and then applied to the filter for shaping.

VIRS Pedestal: This stage sets the levels (luminance) of the VIR signal.

20T Modulation: This stage couples the modulated sine-squared pulse to the modulator. A single ended input signal is converted to a push-pull (balanced) output.

Modulator: The modulator combines the various chroma input signals. The resulting output is coupled through the Bandpass Filter to the Chrominance Amplifier.

Diagram ⟨9⟩

Sync Generator: This stage generates the composite sync used by the 147 for the FULL FIELD TEST SIGNALS.

Basically, the stage consists of a one shot multi which (1) is toggled at a line rate to produce the line sync and (2) toggled at two times the line rate to produce the equalizing and serration pulses.

Sync Lock Detector: This stage is used to sense any difference between the internally generated composite sync and the reprocessed composite sync. Any difference will switch the Program Control Relay which bypasses any signal at the PROGRAM LINE IN to the PROGRAM LINE OUT if sync is not present or the 147 is not locked.

Sync Output Amplifier: This stage is used to set the amplitude of the reprocessed composite sync and provides sufficient current to drive the COMPOSITE SYNC OUT.

Subcarrier Output Amplifier: This stage sets the amplitude of the internally generated subcarrier and provides sufficient current to drive the CW SUBCARRIER OUT.

Reed Switch: This switch opens the CW Subcarrier output line in the event burst is lost from the driving source.

Diagram ⟨10⟩

The Low Voltage Power Supplies provide the following voltages for the 147: −15 volts, +5 volts, and +15 volts. Electronic regulation is used providing stable low ripple output voltages. The primary circuit of the transformer employs voltage and range selector plugs to permit selection of the line voltage operating range.

NOTES

SECTION 4
MAINTENANCE AND CALIBRATION

Introduction

This section of the manual contains information for use in preventive maintenance, troubleshooting, corrective maintenance, and the performance check/calibration of the 147.

PREVENTIVE MAINTENANCE

General

Preventive maintenance consists of cleaning, visual inspection, and lubrication. Preventive maintenance performed on a regular basis may prevent instrument breakdown, and will improve the reliability of this instrument.

Cleaning

General. The 147 should be cleaned as often as operating conditions require. Accumulation of dirt in the instrument can cause overheating and component breakdown. Dirt on components acts as an insulating blanket that prevents efficient heat dissipation. It also provides an electrical conduction path.

CAUTION

Avoid the use of chemical cleaning agents which might damage the plastics used in this instrument. Avoid chemicals which contain benzene, toluene, xylene, acetone, or similar solvents.

Exterior. Loose dirt accumulated on the outside of the 147 can be removed with a soft cloth or small paint brush. The paint brush is particularly useful for dislodging dirt on and around the front-panel controls. Dirt which remains can be removed with a soft cloth dampened in a solution of water and mild detergent. Abrasive cleaners should not be used.

Interior. Dust in the interior of the instrument should be removed occasionally due to its electrical conductivity under high-humidity conditions. The best way to clean the interior is to blow off the accumulated dust with dry, low velocity air. Remove any dirt which remains with a soft paint brush or a cloth dampened with a mild detergent and water solution. A cotton-tipped applicator is useful for cleaning in narrow spaces.

Lubrication

The reliability of switches and other moving parts can be maintained if they are kept properly lubricated. Use a cleaning-type lubricant (e.g., Tektronix Part No. 006-0172-00) for switch contacts. This lubricant does not affect the electrical characteristics of the switch. To lubricate the switch detent, use a heavier lubricant (e.g., Tektronix Part No. 006-0219-00). Do not over-lubricate.

Visual Inspection

The 147 should be inspected occasionally for such defects as broken connections, loose or disconnected pin connectors, improperly seated solid-state devices, damaged circuit boards and heat-damaged components.

The corrective procedure for most defects is obvious; however, particular care must be taken if heat-damaged components are found. Overheating usually indicates other trouble in the instrument; therefore, it is important that the cause of overheating be corrected to prevent recurrence of the damage.

Transistor and Integrated Circuit Checks

Periodic checks of the transistors and integrated circuits (IC's) used in the 147 are not recommended. The best indication of performance is the actual operation of the component in the circuit. Performance of the circuit is thoroughly checked when performing either the performance check or calibration procedure. Any substandard transistors or integrated circuits will usually be detected at that time.

Performance Checks and/or Calibration

To insure correct and accurate instrument operation, the instrument performance and calibration should be checked each 1000 hours of operation or at least every 6 months.

The calibration procedure can be helpful in isolating major troubles in the instrument. In some cases, minor troubles not apparent during normal operation may be revealed and corrected during calibration.

TROUBLESHOOTING

Introduction

The following information is provided to facilitate troubleshooting of the 147. Information contained in other sections of this manual should be used along with the following information to aid in locating the defective component. An understanding of the circuit operation is very helpful in locating troubles.

Troubleshooting Aids

Diagrams. Circuit diagrams are provided on foldout pages at the rear of this manual. Each component, its electrical value and circuit number are shown on the diagrams. In addition, typical voltages which can be expected are also shown.

Each diagram has been assigned a diagram number and name. For example, the first diagram has been assigned the number 0a and is called PROGRAM LINE AMPLIFIER. (Other circuitry exists on this diagram but, since the program line amplifier is of prime importance, it was so called.) Notice the solid blue line that surrounds most of the circuitry on this diagram. This line is used to identify a particular circuit board on which the components are physically located. Also, note the A0 printed on this blue line. This "Reference Designator" allows for correlation between the diagrams, circuit boards, and electrical parts list. All other components on the A0 circuit board will be found on diagram 0b.

Table 4-1 lists the various reference designators, circuit boards, and electrical numbers used in the 147. All components located outside the blue line are chassis mounted components and have circuit numbers from 9000 to 9499.

TABLE 4-1

Designator	Circuit Board Name	Circuit Numbers
A9	Subcarrier & Sync	0-499
A0	VIT Adder	500-999
A1	Vertical Counter	1000-1999
A2	Horizontal Timing	2000-2999
A3	APL Staircase & Noise	3000-3999
A4	VIT & Full Field	4000-4999
A5	Genlock	5000-5999
A6	Function Generator	6000-6999
A7	Output Amplifier	7000-7999
A8	Modulator	8000-8999
A10	Power Supply	9500-9999

Circuit Boards. Fig. 4-1 shows the location of each circuit board within the instrument. Each circuit board is shown (full view) opposite the appropriate diagram in the diagram section. Each electrical component on the board is identified by its circuit number. In most cases, these circuit numbers were assigned on a grid system as a convenience to the user of the instrument. For example, notice the circuit board photo opposite diagram 0a. The upper right hand corner of this board has been assigned numbers around 500. Proceeding right to left, notice the numbers go towards 590 at the upper left hand corner. Going down, notice the numbers increase to 990 at the bottom left corner and 919 at the bottom right corner. Using this method, the physical location of each component is readily available.

Waveforms. Important waveforms (typical) are given opposite the appropriate diagram in the diagram section. These waveforms aid in determining if a circuit is functioning properly.

Wire Color Codes. All insulated wires in the 147 are color coded to facilitate circuit tracing. Table 4-2 summarizes the coding system used in the 147.

TABLE 4-2

Color Code	Significance
Black	Chassis Ground
White on Black	Floating Ground
Yellow on Green	Safety ground
Brown[1]	Filament and heaters
Gray[1]	AC line
White[1]	Signal
Red[2]	B+
Violet[2]	B–

Resistor Color Code. In addition to the brown composition resistors, metal film resistors (identified by their gray or light blue color) are used in the 147. The resistance values of composition and metal film resistors are color-coded on the components with the standard EIA color code.

Capacitor Markings. The capacitance value of a common disc capacitor or small electrolytic is marked in microfarads on the side of the component body. The white ceramic capacitors used in the 147 are color-coded in picofarads using a modified EIA code. The new "tear drop" capacitors

[1] Color Stripes are used on these wires as an aid to circuit tracing.

[2] Color stripe on wire indicates position of supply with respect to 0 volts (e.g., a black stripe on a red wire would be the first voltage in the positive direction). If a second stripe is used (white only), this indicates a non-regulated supply.

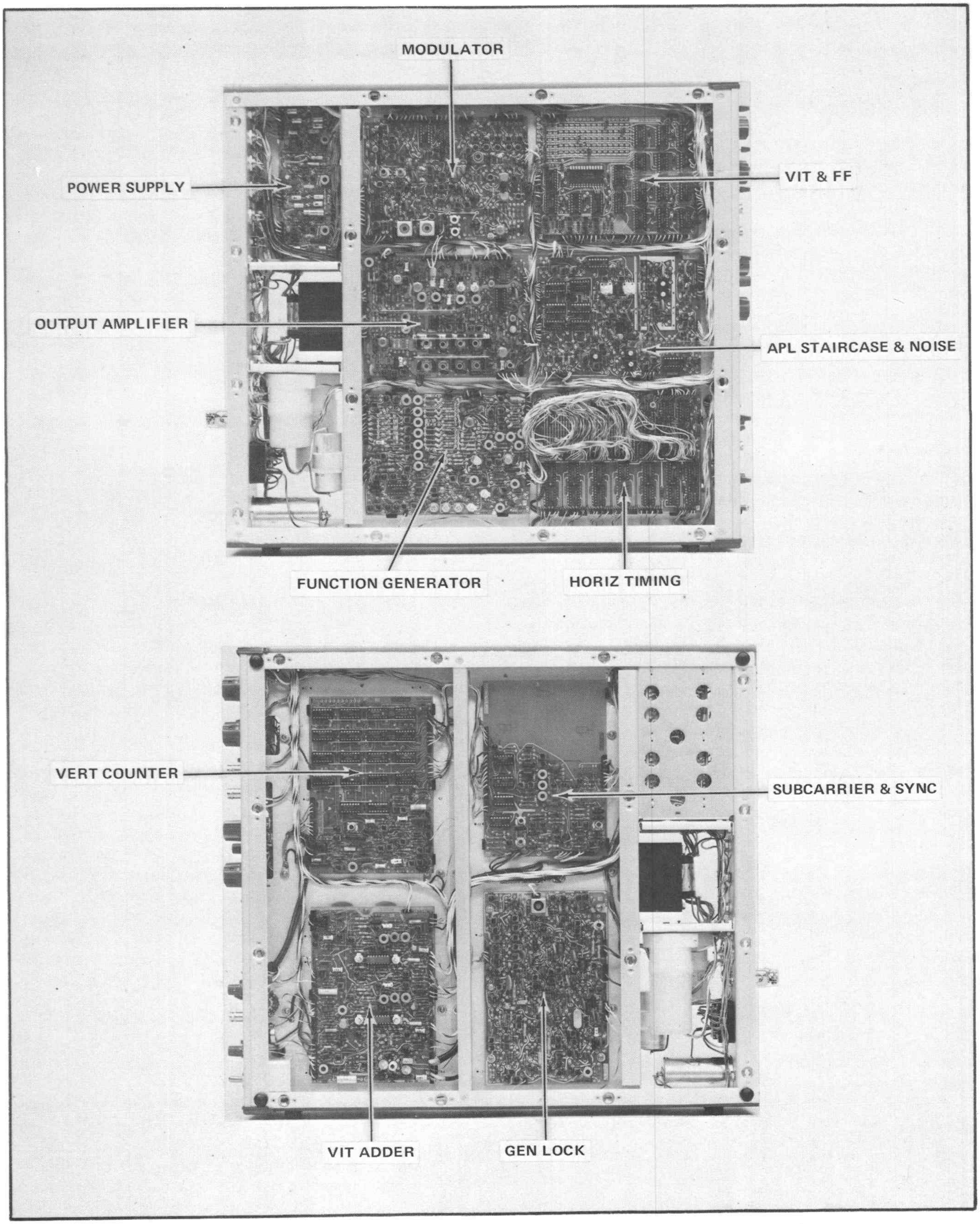


Fig. 4-1. Location of circuit boards in the 147.

are color-coded in microfarads using a modified EIA code, with the dot indicating both temperature and the negative (—) side.

Troubleshooting Techniques

This troubleshooting procedure is arranged in an order which checks the simple possibilities before proceeding with extensive troubleshooting.

1. Check Control Settings. Incorrect control settings can indicate trouble that does not exist. If there is any question about the correct function or operation of any control, see the Operating Instructions.

2. Check Operation of Associated Equipment. Many times malfunction of equipment can be traced to associated equipment.

3. Visual Check. Visually inspect the portion of the instrument in which the trouble is located. Look for unsoldered connections, loose pin connectors, broken wires, damaged circuit boards, damaged components, etc.

4. Check Circuit or Instrument Calibration. The apparent trouble may only be a result of misadjustment and may be corrected by calibration. Complete calibration instructions are given in this section.

5. Isolate Trouble to a Circuit. To isolate trouble to a circuit, note the trouble symptoms. The symptoms often identify the circuit in which the trouble is located. When trouble symptoms appear in more than one circuit, check affected circuits by taking voltage and waveform readings.

Incorrect operation of all circuits often indicates trouble in the power supply. Check first for correct voltage of the individual supplies. A defective component elsewhere in the circuit can also appear as a power supply trouble, and affect the operation of other circuits.

The Circuit Description section of this manual can be used as a guide for isolating a trouble. This description explains how the various signal components are combined to form the video signal. By using the front-panel controls and checking the signals at the BNC connectors, it is possible to determine circuits that are functioning properly and those that are not.

When a trouble is isolated to the smallest possible area, proceed with steps 6 through 8 in this troubleshooting procedure to locate the defective component(s).

6. Check Circuit Board Interconnections. After the trouble has been isolated to a particular area or circuit, check the pin connectors on the circuit board for correct connection.

The pin connectors used in this instrument also provide a convenient means of circuit isolation. For example, a short in a power supply can be isolated to the power supply itself by disconnecting the power distribution pin connectors for the voltage at the Power Supply board when making resistance to ground checks.

7. Check Voltage and Waveforms. Often the defective component can be located by checking for the correct voltage or waveform in the circuit. Typical voltages and waveforms are given in the diagrams section.

NOTE

Voltages and waveforms given on the diagrams are not absolute and may vary slightly between instruments. To obtain operating conditions similar to those used to take these readings, see the back side of the diagrams title page.

CAUTION

Due to the component density on the circuit boards, care should be taken with meter leads and probe tips. Accidental shorts can cause abnormal voltages or transients which may destroy many components.

WARNING

"Ground lugs" are not always at ground potential. Check the diagrams before using such connections as a ground for the voltmeter test prod or oscilloscope probe. Some transistor cases may be elevated.

8. Check Individual Components. The following procedures describe methods of checking components in the 147. Components which are soldered in place should be checked without removal, by isolating the component if circuit conditions allow. If component isolation is questionable, unsolder one end to check.

a. Transistors (excluding FETS). The best check of transistor operation is actual performance under operating conditions. If a transistor is suspected of being defective, it can best be checked by substituting a new transistor. However, be sure that circuit conditions are not such that a replacement might also be damaged. If substitute transistors are not available, use a dynamic tester such as the Tektronix Type 576.

b. Diodes. A diode can be checked for an open or shorted condition by measuring the resistance between terminals.

CAUTION

Do not use an ohmmeter range that has a high internal current. High current may damage the diodes.

9. Repair and Readjust the Circuit. If any defective component or part is located, follow the replacement procedure given in this section. Be sure to check the performance of any circuit that has been repaired or that has had any electrical components replaced.

CORRECTIVE MAINTENANCE

General

Corrective maintenance consists of component replacement and instrument repair. Special techniques or procedures required to replace components in this instrument are described here.

Obtaining Replacement Parts

All electrical and mechanical replacement parts for the 147 can be obtained through your local Tektronix Field Office or representative. However, many of the standard electronic components can be obtained locally in less time than is required to order from Tektronix, Inc. Before purchasing or ordering replacement parts, consult the Parts List for value, tolerance, and rating.

NOTE

When selecting replacement parts, it is important to remember that the physical size and shape of a component may affect its performance at high frequencies.

Multiple Terminal Connector Holders. Most inter-circuit connections between the circuit boards, or between the boards and chassis mounted components, are made through pin connectors. The terminals in the connector holder are identified with numbers. Connector orientation to the circuit board is keyed with triangles, one on the holder and one on the circuit board. See Fig. 4-2.

Circuit Boards. If the circuit board is damaged beyond repair, replacement can be made of the entire assembly including all soldered-on components, or of the board alone. Part numbers are given in the Mechanical Parts List for either the completely wired or the unwired board.

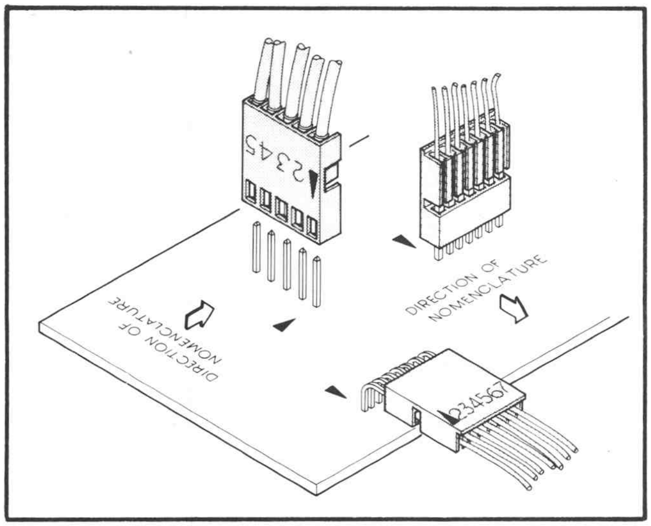


Fig. 4-2. Multipin circuit board connectors.

Transistor and Integrated Circuit Replacement. Transistors and integrated circuits, (ICs) should not be replaced unless they are actually defective. Replacement or exchange of components may affect the calibration of the instrument. If a transistor or integrated circuit is removed during routine maintenance, return it to its original socket.

Any replacement component should be of the original type or a direct replacement. Bend the leads to fit the socket and cut the leads to the same length as on the component being replaced.

The chassis-mounted power supply transistors and their mounting bolts are insulated from the chassis. In addition, silicone grease is used to increase heat transfer capabilities. Re-install the insulators and replace the silicone grease when replacing these transistors. The grease should be applied to both sides of the mica insulators, and should be applied to the bottom side of the transistor where it comes in contact with the insulator.

WARNING

Voltages are present on the exterior surface of the chassis-mounted power supply transistors if the power is applied to the instrument and the POWER switch is on.

After any component is replaced, check the operation and calibration of the associated circuits.

Indicator Lamp Replacement. To remove the POWER ON indicator lamp, remove the top dust cover from the instrument, then reach behind the front panel and unplug the lamp from its socket. To replace the lamp, reverse the procedure.

The NONSYNCHRONOUS MODE—NO VITS, PROGRAM, PREVIEW, VIRS INCOMING, VIRS INSERT, and VIRS DELETE indicators consist of two parts; (1) a lens which is attached to the instrument and (2) a lens cap (connected to the back of the lens) into which the lamps have been soldered. To remove the lamps, reach behind the front-panel, grasp the lens cap and pull straight away from the front-panel. The lens cap will unsnap from the lens, allowing lamp access. Unsolder the lamp. To replace, solder the new lamp into the lens cap. Then, place the lens cap on the back of the lens and apply enough pressure to snap the cap into place over the lens.

Fuse Replacement. Both line fuses are contained in plastic holders in the cover for the Line Voltage Selector Assembly at the rear of the instrument. Use only the correct value replacement fuse. Only the upper fuse within the assembly (3/4 A) is used for 115-volt operation. However, for 230-volt operation both the upper and lower fuse (1/2 A) must be installed.

Switches. If a switch is defective, replace the entire assembly. Replacement switches can be ordered by referring to the Parts List for the applicable part numbers.

Power Transformer Replacement. If the power transformer becomes defective, contact your local Tektronix Field Office or representative for replacement. Replace only with a direct replacement Tektronix transformer.

PERFORMANCE CHECK/CALIBRATION

Introduction

This portion of the manual is intended to provide qualified personnel with information which, when followed, will (1) insure the instrument is operating to the specifications listed in Section 1 or (2) allow the instrument to be calibrated to meet or exceed the specifications.

Limits, tolerances, and waveforms in this procedure are given as guides and are not instrument specifications unless given in the Specification section. The instrument should not require frequent calibration, but an occasional adjustment will be necessary when transistors, integrated circuits, and other components are changed. Also, a periodic calibration is desirable from the standpoint of preventive maintenance. The calibration of the instrument should be checked after every 1000 hours of operation or each six months if used intermittently.

TEST EQUIPMENT REQUIRED

General

All of the following test equipment, or its equivalent, is required for complete calibration. The equipment required for the performance check is so noted.

Specifications given are the minimum necessary for accurate indication. All test equipment is assumed to be correctly calibrated and operating within the given specifications. If equipment is substituted, it must meet or exceed the specifications of the recommended equipment.

NOTE

The degree of accuracy to which the instrument can be checked or calibrated depends upon the accuracy of the test equipment used.

1. Variable Autotransformer[3]. Must be capable of supplying at least 200 volt-amperes over a voltage range of 90 to 136 volts (180 to 272 volts for 230-volt nominal line). If the autotransformer does not have an AC Voltmeter to indicate output voltage, monitor the output with an AC Voltmeter (RMS) with a range of at least 136 (or 272) volts. For example, General Radio W10MT3W Metered Variac Autotransformer.

2. DC Voltmeter[3]. Accuracy within ±0.1%; range, 5 to 15 volts. For example, Tektronix 7000 Series Oscilloscope with readout and 7D13 Digital Multimeter Plug-In Unit or Fluke Model 825A.

3. Test Oscilloscope[4]. Bandwidth, DC to at least 30 MHz; minimum deflection factor, 1 mV/division; two input channels providing choice of independent channel operation or differential operation; sweep magnification, X100. For example, a Tektronix 7000 Oscilloscope with 7A13, 7B70, and 7B71 Plug-In Units, or Tektronix Type 547 with Type 1A5 Plug-In Unit.

4. Spectrum Analyzer. Center frequency, from 1 MHz to 5 MHz accurate within 1% using crystal controlled markers as a reference; frequency span, calibrated and

[3] **Required only for calibration procedure.**

[4] **Required only for calibration procedure and instrument return loss checks.**

adjusted to 10 MHz/division accurate to within 10%; RF attenuation range, 0 dB to 60 dB in 10 dB steps accurate within 0.5 dB +1% of dB reading. A Tektronix 1401A Spectrum Analyzer with a Tektronix 323 oscilloscope is used in this procedure.

5. Waveform Monitor. Tektronix Type 529 Waveform Monitor recommended.

NOTE

The vertical amplifier must be DC Coupled; see Operating Instructions in Type 529 Manual for details.

6. Vectorscope. Tektronix Type 520 NTSC Vectorscope recommended.

7. RMS Voltmeter. Must be capable of measuring 700 mV RMS within 1%; Must be capable of indicating dB accurate within 1 dB. For example, Hewlett-Packard Model 3400A.

8. Video Signal Source. Tektronix Type 140 NTSC Test Signal Generator recommended.

9. Calibration Fixture. Tektronix Calibration Fixture 015-0213-00.

10. Constant Amplitude Signal Generator[4]. Output Voltage, at least 500 mV; frequency range, 50 kHz and variable from 1 MHz to 5 MHz. Tektronix Type 191.

11. Return Loss Bridge[4]. Tektronix Part No. 015-0149-00.

12. Minimum Loss Attenuator[4]. Type, minimum loss when going from a 50 Ω system to a 75 Ω system. Tektronix Part No. 011-0057-00.

13. Terminations (3). Type, end-line; connectors, BNC; impedance, 75 Ω. Tektronix Part No. 011-0102-00.

14. Cables (7). Impedance, 75 Ω; connectors, BNC. Tektronix Part No. 012-0074-00.

15. Attenuator. Attenuation, X10; impedance, 75 Ω; connectors, BNC. Tektronix Part No. 011-0061-00.

16. Adapter. Type, BNC-T. Tektronix Part No. 103-0030-00.

17. Termination. Type, feed-thru; impedance, 75 Ω; connectors, BNC. Tektronix Part No. 011-0055-00.

18. Adjustment Tools	Tektronix Part No.
Tool: 1-1/2 inch shaft; 5 inches total length, plastic shaft and handle, metal screwdriver tip.	003-0000-00
Rod: 5 inches long, Plastic, for 0.100 inch inside diameter powered iron hex slugs.	003-0301-00
Handle: Nylon	003-0307-00
Insert; 0.077 inch outside diameter for 5/64 inch inside diameter hex cores.	003-0310-00
Screwdriver: 1/8 inch bit width, plastic handle and metal shaft.	XceLite R3323

SHORT FORM CALIBRATION

This procedure is provided as an aid in calibration of the 147. It lists the actual adjustments recommended in order, but does not include the checks in the calibration procedure. It should only be used by an experienced calibrator who is familiar with the long form calibration procedure.

1. Insure that your waveform monitor luminance and chrominance gains are correct; the external video source should be 1 volt peak to peak with the blanking level at 0 volts.

2. Procedure

GROUP 1—INITIAL Page 4-11

a. Set R9851 for −15 volts.

b. Set R9831 for +15 volts.

c. Set R9801 for +5 volts.

d. Repeat parts a, b, and c because of interaction.

e. Set L1670 (1 MHz Oscillator) for triggered display.

f. Set R1988 (Sync Delay) until the INSERT DELAY (front-panel control) has a range of ±0.5 μs.

g. Set L94 (Subcarrier Amplitude) for maximum CW SUBCARRIER; ≈2 volts peak to peak.

h. Set L20 and L30 (Sync Filter) for best leading corner on COMPOSITE SYNC.

GROUP 2—OUTPUT LEVELS Page 4-13

a. Set R7735 (Reference Pedestal Amplitude) for 100 IRE.

b. Set R8730 (Sync Amplitude) for −40 IRE.

c. Set R7733 (DC Level) for blanking level at 0 volts.

d. Set R8960 and C8689 (Modulator Balance) for minimum modulation on multiburst blanking level.

e. Set R6938 (Multiburst Setup Level) fully clockwise.

f. Set R6833 (Multiburst Pedestal Amplitude) for 100 IRE.

GROUP 3—MODULATED PULSE LUMINANCE Page 4-15

a. Set R8750 (Modulation Balance) for minimum modulation on the SIN^2 PULSE AND BAR blanking level.

b. Remove connector on pins 2 and 3 of P6050 (12.5T) and connect it to pins 1 and 2 (20T).

c. Set R6458 (20T Level) for best trailing corner on modulated pulse.

d. Set R6362 (20T Symmetry) for symmetrical pulse measured at HAD points.

e. Set R6354 (20T Width) for pulse width of 2.5 μs measured at HAD points.

f. Return connector on pins 1 and 2 of P6050 to pins 2 and 3 (12.5T).

GROUP 4—MULTIBURST Page 4-15

a. Set R6304 (MB 500 kHz) for 500 kHz.

b. Set R6202 (MB 1.5 MHz) for 1.5 MHz.

c. Set R6314 (MB 2.0 MHz) for 2.0 MHz.

d. Set R6324 (MB 3.0 MHz) for 3.0 MHz.

e. Set R6334 (MB 3.58 MHz) for 3.58 MHz.

f. Set R6344 (MB 4.2 MHz) for 4.2 MHz.

g. Set R6898, R6997, C6693, and C6788 (MB Harmonics) for minimum harmonics; should be 40 dB down.

h. Repeat parts a through g because of interaction.

i. Set R2715 (MB Length) for 3 cycles of 500 kHz multiburst and equal stops on all other bursts.

j. Set R6673 (MB Centering) for a display as shown in Fig. 4-11.

k. Set R6836 (MB Center Level) to set the center of multiburst at 55 IRE.

l. Set R6741 (MB Gain) for a peak to peak amplitude of 90 IRE.

m. Set R6942 (MB Sync Level) to match the vertical interval sync.

n. Set C7463 (REDUCED MB Flatness) for flat multiburst; 1 IRE tilt or less.

o. Set C7461 (NORMAL MB Flatness) for flat multiburst; 1 IRE tilt or less.

GROUP 5—OUTPUT FILTERS Page 4-18

a. Preset L7110 for a 2T Pulse (SIN^2 PULSE AND BAR) amplitude of 100 IRE.

b. Set L7301, L7401, L7501, and L7691 (2T Filter) for clean trailing corner on 2T Pulse; ringing 0.5 IRE or less.

c. Set L7110 (2T Pulse Amplitude) for 100 IRE.

d. Change the connector on pins 5 and 6 of P7321 to pins 4 and 5; change the connector on pins 1 and 2 of P7131 to pins 2 and 3.

e. Preset R7131 for a T Pulse amplitude of 100 IRE.

f. Set L7311, L7411, L7511, and L7611 (T Pulse Amplitude) for clean trailing corner on T Pulse; ringing 1.0 IRE or less.

g. Set R7131 (T Pulse Amplitude) for 100 IRE.

h. Change the connector on pins 4 and 5 of P7321 to pins 5 and 6; change the connector on pins 2 and 3 of P7131 to pins 1 and 2.

i. Set R7143 (Bar Amplitude) for 100 IRE.

GROUP 6—MODULATED PULSE CHROMA AND VARIABLE PHASE Page 4-19

a. Set L8580 (Subcarrier Harmonics) for minimum harmonics; at least 40 dB down.

b. Set L8590 (Modulation Delay) for symmetrical base of modulated pulse.

c. Set R7661 (Modulation Gain) and R7357 (Luminance Gain) for peak modulated pulse of 100 IRE (within 0.5 IRE of bar amplitude) and a flat base (flat within 1 IRE).

d. Set R7453 (P & B Sync Level) to match the vertical interval sync.

e. Preset R8060 (12.5T Phase) fully clockwise; set L8050 and L8150 (Variable Modulation Filter) for a display similar to that shown in Fig. 4-16.

GROUP 7—LINEARITY Page 4-20

a. Set C3565 (5 Step Amplitude) for a peak amplitude of 80 IRE.

b. Set C3470 (10 Step Amplitude) for a peak amplitude of 90 IRE.

c. Set R3616 (Ramp Amplitude) for a peak amplitude of 100 IRE.

d. Set R3410 (40 IRE Modulation Amplitude) for LINEARITY modulation of 40 IRE peak to peak.

e. Change the connector on pins 2 and 3 of P3400 to pins 1 and 2.

f. Set R3420 (20 IRE Modulation Amplitude) for LINEARITY modulation of 20 IRE peak to peak.

g. Change the connector on pins 1 and 2 of P3400 to pins 2 and 3.

h. Set R8620 (Burst Amplitude) for a burst amplitude of 40 IRE peak to peak.

i. Set L8640 (Burst Filter) for the best front corner on burst; risetime 375 ns within 15%.

GROUP 8—VIRS Page 4-21

a. Set R8380 (VIRS Modulation Amplitude) for VIRS modulation of 40 IRE peak to peak.

b. Set R8830 (VIRS 7.5 Level) for a setup amplitude of 7.5 IRE within 0.5 IRE.

c. Set R8930 (VIRS 50 Level) for a center level of 50 IRE within 0.5 IRE.

d. Set R8835 (VIRS 70 Level) to set the center of VIRS modulation at 75 IRE within 0.7 IRE.

e. Set L8190 and L8390 (VIRS Modulation Filter) for best risetime of VIRS modulation; should be 1 μs within 15%.

f. Set R8030 (VIRS Detector) for proper VIRS INSERTION lamp operation.

GROUP 9—VIT ADDER Page 4-22

a. Set C560 and C580 (Return Loss) for a return loss of at least 40 dB. (147 POWER switch must be OFF.)

b. Set R7361 (Auxiliary Sync Level) for a display as shown in Fig. 4-20.

c. Set R785 (Program DC Level) for no DC shift between AUXILIARY and PREVIEW.

d. Set R775 (Program Sync Level) to align the blanking levels.

e. Set R505 (Program Gain) to match peak amplitude of internal and external signals.

f. Set R765 (Program Luminance Gain) for no shift between AUXILIARY and PREVIEW. (SN B070528-up) Set R895, Program Bandwidth for minimum transient amplitude.

g. Set C779 (MB VIT Flatness) for no tilt of VIT Multiburst; tilt, 1 IRE or less.

h. Set C749 (Program Chroma Gain) for chroma match between AUXILIARY and PREVIEW.

i. Set R735 (Diff Phase) for minimum differential phase; ±0.15° or less.

j. Set L5101 (VIRS Phase) to match external burst and internal VIR phase.

k. Set R985 (Preview DC Level) to match PROGRAM DC level, 0 volts ±50 mV.

l. Set R975 (Preview Sync Level) to match sync pulses.

m. Set R965 (Preview Gain) for 140 IRE peak to peak.

n. Set C879 (Preview MB Flatness) for no tilt of VIT Multiburst; tilt, 1 IRE or less.

o. Set C849 (Preview Flatness) to superimpose burst and VIR vectors.

p. Set R7993 (Ext VIT Gain) to match VIT signals.

q. Set R3270 (Noise Bandwidth) fully clockwise.

r. Set R3260 (Noise Amplitude) for 700 mV RMS.

s. Set R7561 (Noise Match) to match inserted noise with continuous noise.

GROUP 10—TIMING Page 4-27

a. Set R1988 (Sync Delay) to null leading edge of line sync pulses.

b. Set R250 (Sync Width) to null trailing edge of line sync pulses.

c. Set R150 (Equalizer Width) to null the equalizer pulses.

d. Set R350 (Serration Width) to null the serration pulses.

e. Set R5929 (3.58 MHz Adj) for minimum rotation of vector.

PERFORMANCE CHECK/CALIBRATION PROCEDURE

General

The following procedure is arranged in a sequence designed for checking or calibration with minimum interaction. However, some adjustments will interact and will be so noted in those steps involved.

Steps titled CHECK or CHECK/ADJUST are a combined Performance Check or Calibration procedure. Exceptions are noted in the step title. When performing a Performance Check, do not do the ADJUST portion of that step.

The 147 front- and rear-panel controls and connectors are capitalized (e.g., LINEARITY 5 STEPS). Internal adjustment titles are initial capitalized only (e.g., +5 Volts Adj).

The following procedure uses the equipment previously listed in this section. If substitute equipment is used, control settings may need to be altered to meet the requirements of the equipment used.

NOTE

All waveforms shown in this procedure are actual photographs taken with a Tektronix Oscilloscope Projected Graticule Camera System.

Preliminary Procedure

1. Connect the autotransformer to a suitable power source and the 147 to the autotransformer.

2. Set the autotransformer to the design center voltage for the LINE VOLTS selector switch position being used.

3. Set the 147 switches as follows and allow at least 20 minutes at 25°C, ±5°C before checking or calibrating the instrument to the given accuracy.

POWER	ON
PROGRAM CONTROL	
UNITY GAIN/VAR	UNITY GAIN
PROGRAM/PREVIEW/ AUXILIARY	PROGRAM
REMOTE/LOCAL	LOCAL
NOISE AND PEDESTAL	
NOISE	DELETION
PEDESTAL	100 IRE
NOISE LEVEL dB	OFF, 0
MULTIBURST	NORMAL
LINEARITY	
SUBCARRIER	ON
Mode	5 STEPS
FULL FIELD SIG	
Mode	NOISE
APL	BOUNCE 10-90
VARIABLE	100
SYNC SOURCE	Up

4. Install the rear-panel REMOTE plug, P9014.

5. Insure that all test equipment is correctly calibrated. It is essential that the waveform monitor luminance and chrominance gains are correct, and the external video source provide a 1 volt peak to peak composite video signal with the blanking level at 0 volts.

GROUP 1—INITIAL

NOTE

Tolerances listed for steps 1, 2, and 3 are not instrument specifications, but serve as guides to determine whether complete calibration is necessary. If a complete calibration is being performed, set each voltage to the exact setting. If performing a partial calibration, remember that an adjustment of any supply may affect the operation of other circuits within the instrument. We, therefore, recommend that no adjustment of the power supplies be made if they are within the listed tolerances.

1. Check/Adjust Power Supply Voltage (Calibration Procedure Only)

a. Connect a precision DC Voltmeter between chassis ground (pin 1 of P9834; see Fig. 4-3) and P9852 (−15 volts).

b. CHECK—Should be −15 volts within 1%.

ADJUST—R9851, −15 Volt Adj, for −15 volts.

c. Connect the voltmeter between chassis ground and P9832 (+15 volts).

d. CHECK—Should be +15 volts within 1%.

ADJUST—R9831, +15 Volts Adj, for +15 volts.

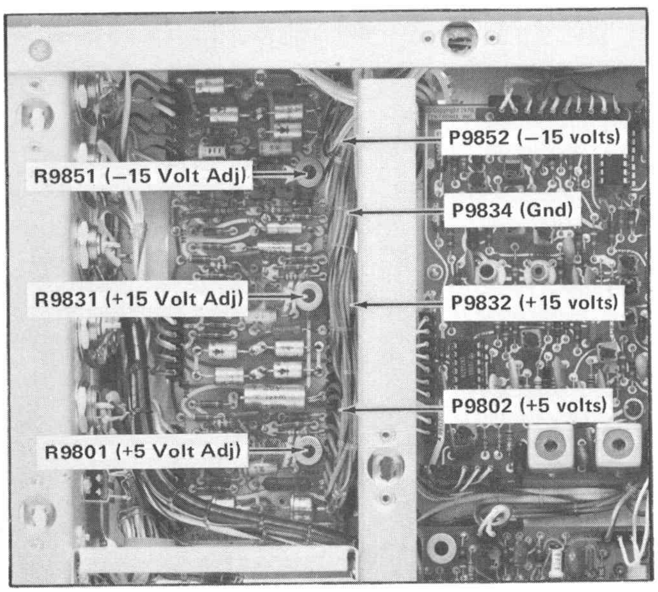


Fig. 4-3. Power Supply test point and adjustment locations.

e. Connect the voltmeter between chassis ground and P9802 (+5 volts).

f. CHECK—Should be +5 volts within 1%.

ADJUST—R9801, +5 Volts Adj, for +5 volts.

g. Repeat the above adjustments to remove any interaction.

2. Check Power Supply Regulation (Calibration Procedure Only)

a. Set the autotransformer output voltage, in turn, to the low and high voltages listed for the LINE VOLTS selector switch position being used. (See Operating Voltage, Section 2 of this manual for details.)

b. CHECK— +5 volts within 1% at each autotransformer output voltage setting.

c. Repeat the above procedure for the +15 and −15 volt power supplies.

d. Disconnect the voltmeter.

3. Check Power Supply Ripple (Calibration Procedure Only)

a. Connect a 1X probe between P9852 (−15 volts) and the test oscilloscope vertical input. Set the vertical unit for a deflection factor of 10 mV using AC coupling. Set the test oscilloscope for a sweep rate of 5 ms/Div with line triggering.

b. While observing the test oscilloscope display, change the autotransformer, in turn, to the low and high voltages listed for the LINE VOLTS selector switch position being used.

c. CHECK—Ripple voltage should not exceed 10 mV peak to peak.

d. Repeat part c for the +15 and +5 volt supplies.

e. Disconnect the 1X probe. Disconnect the autotransformer and reconnect the 147 directly to a suitable power source.

4. Check/Adjust 1 MHz Setup

a. Connect an external 1 volt peak to peak composite video signal to the 147 PROGRAM LINE IN.

b. Connect the 147 rear-panel FULL FIELD TEST SIGNAL OUT to the waveform monitor A Input; terminate the other A Input (loop-thru) into 75 Ω.

c. Connect an external 4 volt peak to peak composite sync signal to the waveform monitor Ext Sync Input; terminate the other Ext Sync Input (loop-thru) into 75 Ω.

d. Set the waveform monitor to view the A Input at a 2 Line display rate using external triggering.

e. CHECK—Waveform monitor display should be triggered.

ADJUST—L1670 (1 MHz Osc), see Fig. 4-4, until the display is triggered.

f. Disconnect all test equipment.

4a. Adjust 1 MHz Setup (Alternate Procedure)

a. Set the test oscilloscope vertical unit for a 1 volt/div deflection factor at a free-running sweep rate of 50 μs/div. Establish a "ground" reference near the bottom of the CRT.

b. Connect a 10X probe between TP1730 (see Fig. 4-4) and the vertical unit; set the vertical unit for DC coupling.

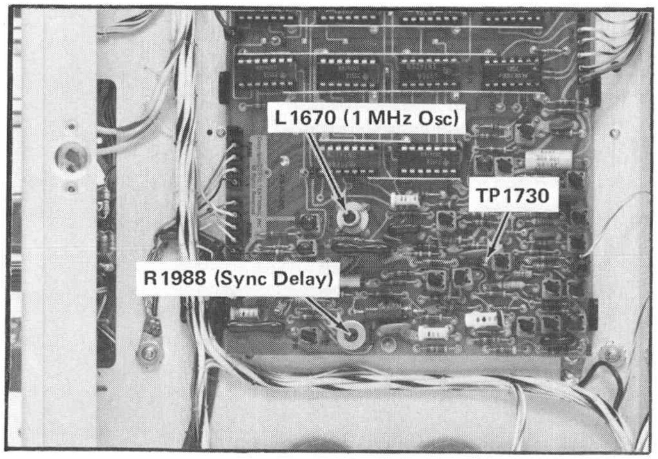


Fig. 4-4. Vertical Counter test point and adjustment locations.

c. CHECK—CRT display DC level should be at approximately 2.5 volts positive.

d. Rotate L1670 (1 MHz Osc) clockwise; the display should move in a positive direction to approximately 5 volts, then oscillate. Rotate L1670 counterclockwise; the display should move towards 0 volts, then oscillate.

e. ADJUST—L1670 to position the display midway between the points of oscillation; should be approximately 2.5 volts positive.

f. Disconnect the 10X probe.

5. Check/Adjust Insert Delay

a. Connect an external 1 volt peak to peak composite video signal to the waveform monitor B Input; connect the other B Input (loop-thru) to the 147 rear-panel PROGRAM LINE IN.

b. From the 147 rear-panel FULL FIELD TEST SIGNAL OUT, connect to the waveform monitor A Input; connect the other B Input (loop-thru) to the vectorscope CH A Input; terminate the other CH A Input (loop-thru) into 75 Ω.

c. Connect the external 4 volt peak to peak composite sync signal to the vectorscope Ext Sync Input; connect the other Ext Sync Input (loop-thru) to the waveform monitor Ext Sync Input; terminate the other Ext Sync Input (loop-thru) into 75 Ω.

d. Connect an external 2 volt peak to peak subcarrier signal (3.579545 MHz) to the vectorscope Ext ϕ Ref Input; terminate the other Ext ϕ Ref (loop-thru) into 75 Ω.

e. Set the 147 FULL FIELD SIG Mode switch to FLAT FIELD, APL switch to VARIABLE, and the VARIABLE switch to 0.

f. Set the external video source to provide "black burst" as the video drive signal. (If using the Type 140, set the Video switch to Off.)

g. Set the waveform monitor to view the A and B Inputs differentially (A minus B) at a Line .125 H/Cm display rate using external triggering.

h. CHECK—Observing the waveform monitor display, rotate the 147 INSERT DELAY control to +, then −.

Ⓐ

Range of control should be 0.5 μs on either side of the null position.

ADJUST—Set the 147 INSERT DELAY control to midrange; adjust R1988 (Sync Delay), see Fig. 4-4, to null the leading edges of sync. Repeat the CHECK portion before proceeding.

NOTE

Final adjustment of R1988 will be covered in Group 10—Timing.

6. Check/Adjust Subcarrier Amplitude

a. Install a 75 Ω 10X Attenuator between the waveform monitor A Input and the cable from the 147 FULL FIELD SIG OUT.

b. Set the waveform monitor to view the A Input using internal triggering.

c. Connect the cable on the 147 FULL FIELD SIG OUT to the CW SUBCARRIER OUT.

d. CHECK—Subcarrier amplitude should be greater than 28 IRE (2 volts, peak to peak).

ADJUST—L94 (Subcarrier Ampl) see Fig. 4-5, for maximum subcarrier.

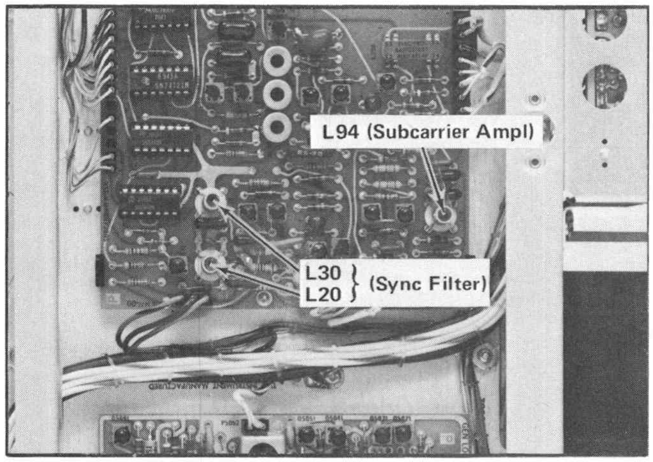


Fig. 4-5. Subcarrier & Sync adjustment locations.

7. Check/Adjust Composite Sync

a. Connect the cable on the 147 CW SUBCARRIER OUT to the COMPOSITE SYNC OUT.

b. CHECK—Composite sync should be between 53.2 and 58.8 IRE (4 volts within 0.2 volt) peak to peak.

c. CHECK—Aberrations on leading corner of sync should be 2% or less (2% of total).

ADJUST—L20 and L30 (Sync Filter) for the best square corner on the leading edge of sync with aberrations 2% or less.

d. Disconnect all test equipment and connections if performing only a partial calibration.

GROUP 2—OUTPUT LEVELS

1. Setup

a. Connect all equipment as given in Group 1, Step 5a, b, c, and d.

b. Set the 147 switches as given in the Preliminary Procedure.

c. Set the waveform monitor to view the A Input (FULL FIELD TEST SIGNAL OUT) at a 2 Line display rate using external triggering, DC coupling, and no DC Restoration.

NOTE

See waveform monitor instruction manual for instructions on DC Coupling. Be sure that the 529 DC Restorer is Off.

2. Check/Adjust Pedestal Amplitude

a. CHECK—Pedestal amplitude should be at 100 IRE within 1 IRE.

ADJUST—R7735 (Reference Pedestal Ampl), see Fig. 4-6, for pedestal amplitude of 100 IRE.

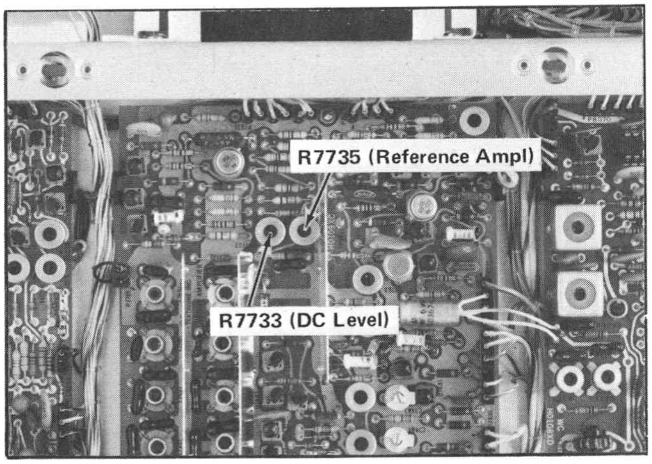


Fig. 4-6. Output Amplifier adjustment locations.

3. Check/Adjust Sync Amplitude

a. CHECK—Sync amplitude should be 40 IRE within 1 IRE.

ADJUST—R8730 (Sync Ampl), see Fig. 4-7, for a sync amplitude of 40 IRE.

4. Check/Adjust Output DC Level

a. Disconnect the waveform monitor A and B Inputs and apply the external video signal to the A Input. Rotate the waveform monitor Vertical Position control to establish a DC reference at the 0 IRE position on the graticule. DO NOT MOVE THE POSITION CONTROL UNTIL THE COMPLETION OF THIS STEP.

b. Reconnect the 147 FULL FIELD TEST SIGNAL OUT to the A Input and the external video to the B Input.

c. CHECK—Blanking level of display should be at 0 IRE within 7 IRE (0 volts within 50 mV).

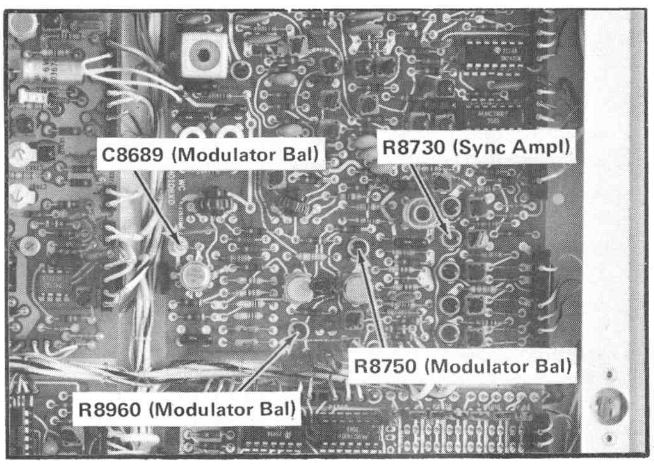


Fig. 4-7. Modulator adjustment locations.

ADJUST—R7733 (DC Level), see Fig. 4-6, to vertically position the blanking level of the display to the reference established in part a.

d. Set the waveform monitor for external triggering.

5. Adjust Modulator Balance (Calibration Procedure Only)

a. Set the 147 FULL FIELD SIG Mode switch to MULTIBURST.

b. Set the waveform monitor for a vertical deflection factor of 0.2 Volt Full Scale.

c. ADJUST—R8960 and C8689 (Modulator Balance), see Fig. 4-7, for minimum modulation on the blanking level of the display.

6. Adjust Multiburst Setup (Calibration Procedure Only)

a. Set R6938 (Multiburst Setup Ampl), see Fig. 4-8, fully clockwise.

NOTE

This is the only adjustment of the control.

7. Check/Adjust Multiburst Pedestal

a. (Performance Check Only). Set the 147 FULL FIELD SIG Mode switch to MULTIBURST.

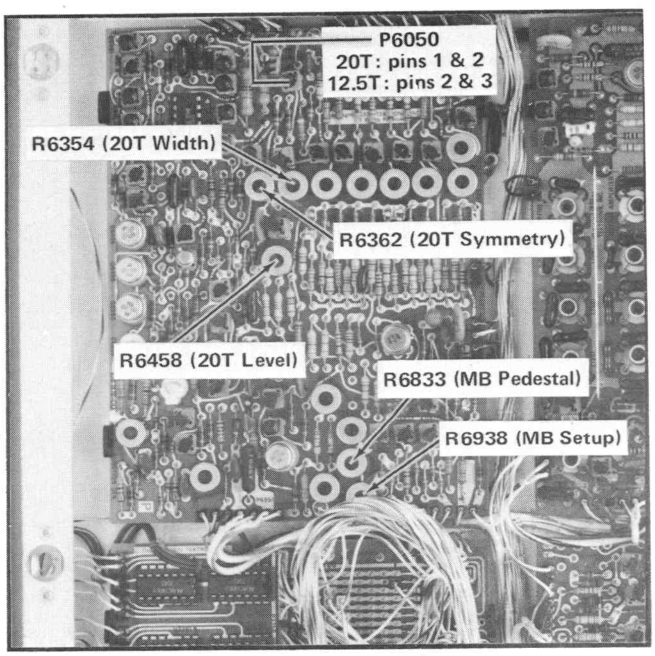


Fig. 4-8. Function Generator pin connector and adjustment locations.

b. (Calibration Procedure Only). Set the waveform monitor for a vertical deflection factor of 1 volt Full Scale (140 IRE).

c. CHECK—Multiburst pedestal should be at 100 IRE within 1 IRE.

ADJUST—R6833 (Multiburst Pedestal), see Fig. 4-8 for a pedestal amplitude of 100 IRE.

d. Disconnect all test equipment if you are forming only a partial calibration.

GROUP 3—MODULATED PULSE LUMINANCE

1. Setup

a. Connect all test equipment as given in Group 1, Step 5a, b, c, and d.

b. Set the 147 switches as given in the Preliminary Procedure except, set the FULL FIELD SIG Mode switch to COMPOSITE.

c. Set the waveform monitor to view the A Input at a Line .125 H/Cm display rate using external triggering, DC Coupling, and no DC Restoration.

2. Adjust Modulator Balance (Calibration Procedure Only)

a. Set the waveform monitor for a vertical deflection factor of .2 volt Full Scale.

b. ADJUST—R8750 (Modulator Balance), see Fig. 4-7, for minimum modulation on the blanking level of the display.

c. Set the waveform monitor for a vertical deflection factor of 1 volt Full Scale.

3. Check/Adjust Modulated Pulse Level, Symmetry, & Width

a. CHECK—Trailing corner of 12.5T pulse should be flat.

CHECK—12.5T pulse should be symmetrical.

CHECK—12.5T pulse width should be 1.57 μs within 75 ns as measured at the HAD points.

NOTE

For Performance Check, proceed to part e.

b. Remove the connector between pins 2 and 3 of P6050, see Fig. 4-8, and connect it between pins 1 and 2 (20 T).

c. ADJUST—R6458 (20 T Level) for the best trailing corner of the pulse.

ADJUST—R6362 (20T Symmetry) for a symmetrical waveform. Measure at HAD points.

ADJUST—R6354 (20T Width) for a pulse width of 2.5 μs within 0.1 μs as measured at the HAD points.

d. Connect the connector on pins 1 and 2 of P6050 between pins 2 and 3 (12.5T); perform part a before proceeding.

e. Disconnect all test equipment if performing only a partial calibration procedure.

GROUP 4—MULTIBURST

1. Setup

a. Connect all test equipment as given in Group 1, Step 5a, b, c, and d.

b. Set the 147 switches as given in the Preliminary Procedure, except set the FULL FIELD SIG Mode switch to MULTIBURST.

c. Connect the 147 FULL FIELD SIG OUT to a spectrum analyzer.

d. Set the vectorscope for a luminance (Y) display of the CH A Input using external sync and burst phasing.

2. Check/Adjust Multiburst Frequencies

a. CHECK—Observing the spectrum analyzer display, check the following frequencies: 500 kHz within 3%, 1.5 MHz within 3%, 2.0 MHz within 3%, 3.0 MHz within 3%, 3.58 MHz within 3%, and 4.2 MHz within 2%.

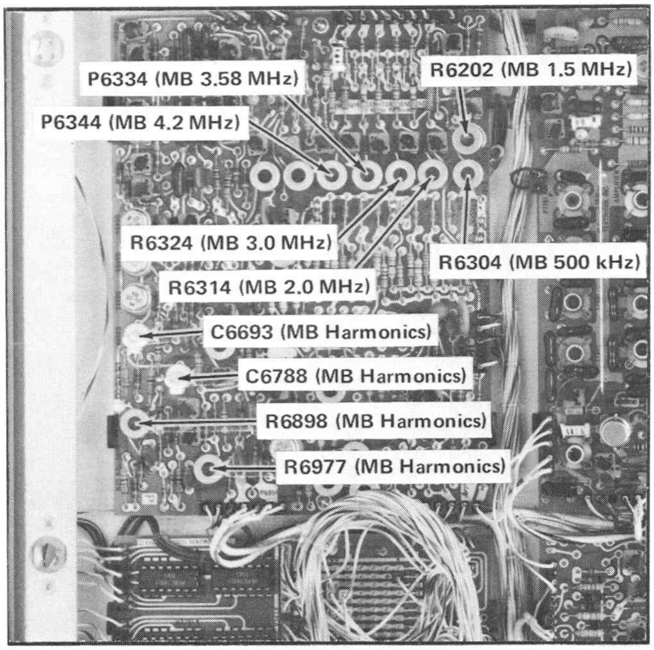


Fig. 4-9. Function Generator adjustment locations.

ADJUST—R6304 (Multiburst 500 kHz), R6202 (Multiburst 1.5 MHz), R6314 (Multiburst 2.0 MHz), R6324 (Multiburst 3.0 MHz), R6334 (Multiburst 3.58 MHz), and R6344 (Multiburst 4.2 MHz); see Fig. 4-9.

3. Check/Adjust Multiburst Harmonic Content

a. Set the spectrum analyzer for a dispersion of 200 kHz/div.

b. CHECK—Multiburst harmonics should be at least 40 dB down.

ADJUST—R6898, R6977, C6693, and C6788 (Multiburst Harmonics) for minimum harmonics; should be at least 40 dB down.

NOTE

If adjustment is made, step 2 must be repeated, as the multiburst frequencies will be affected. Repeat as necessary to remove interaction.

4. Check/Adjust Multiburst Length

a. CHECK—Observe the waveform monitor display of multiburst; there should be 3 cycles of 500 kHz burst with stopping points on all other bursts at the multiburst center level.

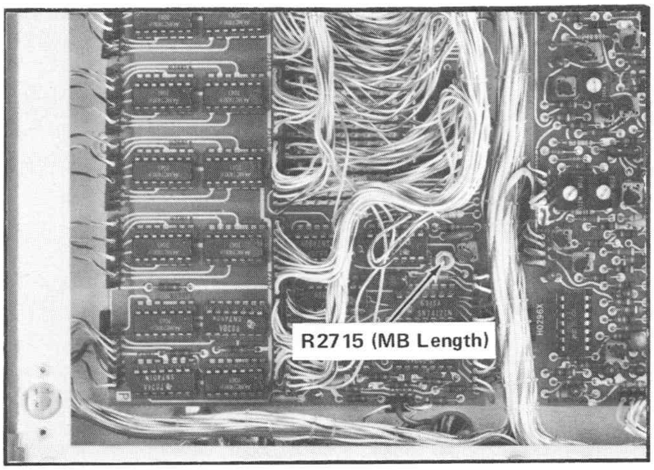


Fig. 4-10. Horizontal Timing adjustment location.

ADJUST—R2715 (Multiburst Length), see Fig. 4-10, for 3 cycles of 500 kHz burst with all other bursts stopping at center level.

5. Check/Adjust Multiburst Centering

a. CHECK—Observe vectorscope display of multiburst; display should be as shown in Fig. 4-11. Notice the position of the last burst (4.2 MHz).

ADJUST—R6673 (Multiburst Centering) see Fig. 4-12, to align the 4.2 MHz burst as shown in Fig. 4-11.

6. Check/Adjust Multiburst Center Level

a. CHECK—Observe the waveform monitor display; center level of multiburst should be at 55 IRE within 1 IRE.

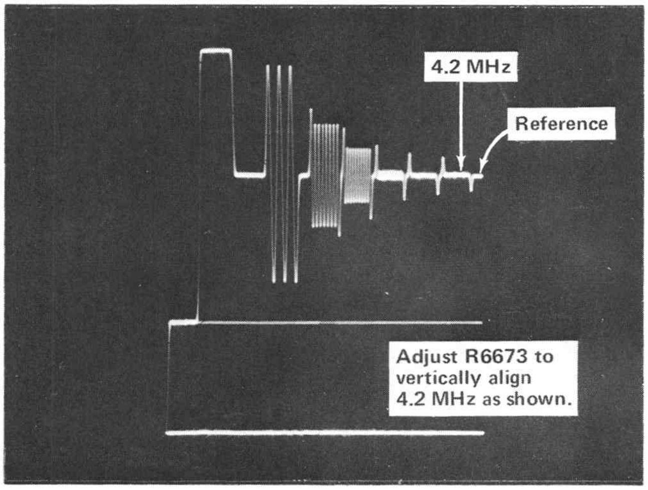


Fig. 4-11. Typical vectorscope display (Y) of Multiburst luminance.

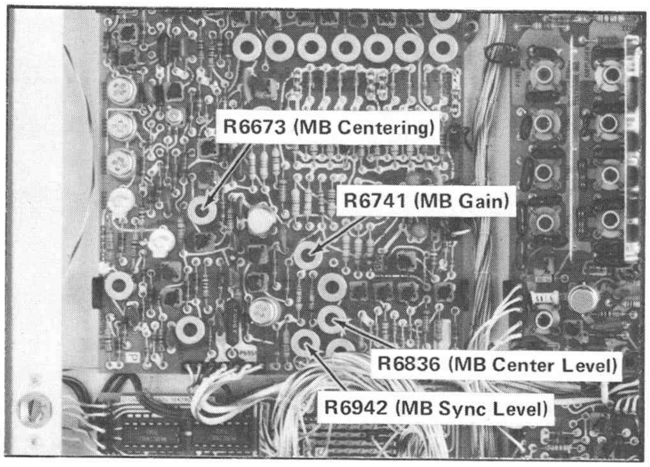


Fig. 4-12. Function Generator adjustment locations.

ADJUST—R6836 (Multiburst Center Level), see Fig. 4-12, to set the center of multiburst at 55 IRE.

b. Set the 147 MULTIBURST switch to REDUCED.

c. Preset C7463, see Fig. 4-13, for minimum tilt of the multiburst.

d. CHECK—Center level of multiburst should be at 40 IRE within 1 IRE.

e. Set the 147 MULTIBURST switch to NORMAL.

f. Preset C7461, see Fig. 4-13, for minimum tilt of the multiburst.

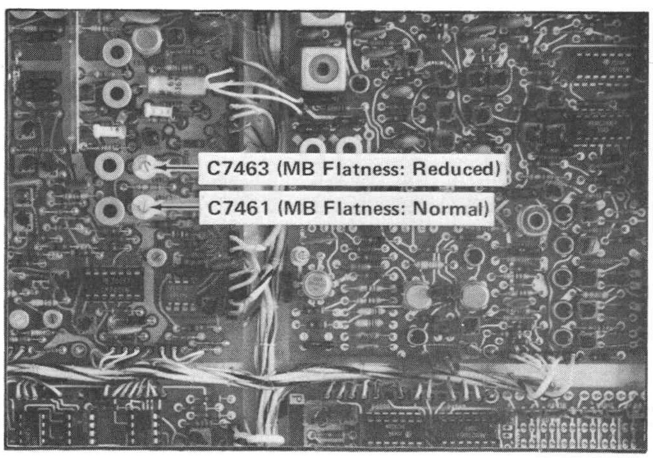


Fig. 4-13. Output Amplifier adjustment locations.

7. Check/Adjust Multiburst Gain

a. CHECK—Observe the waveform monitor display; peak to peak amplitude of multiburst packets should be 90 IRE within 1 IRE.

ADJUST—R6741 (Multiburst Gain) for a peak to peak amplitude of 90 IRE.

b. Set the 147 MULTIBURST switch to REDUCED.

c. CHECK—Peak to peak amplitude of multiburst should be 60 IRE within 1 IRE.

d. Set the 147 MULTIBURST switch to NORMAL.

8. Check/Adjust Multiburst Sync Level

a. Set the waveform monitor for a 2 Field display rate.

b. CHECK—Multiburst field sync should align with multiburst line sync within 1 IRE.

ADJUST—R6942 (Multiburst Sync Level), see Fig. 4-12, to match the sync levels.

9. Check/Adjust Multiburst Flatness

a. Set the waveform monitor for a 2 Line display rate.

b. Set the 147 MULTIBURST switch to REDUCED.

c. CHECK—There should be less than 1 IRE tilt between 500 kHz burst packet and 4.2 MHz burst packet.

ADJUST—C7463 (Reduced Multiburst Flatness), see Fig. 4-13, for flat multiburst (no tilt).

d. Set the 147 MULTIBURST switch to NORMAL.

e. CHECK—There should be less than 1 IRE tilt between 500 kHz and 4.2 MHz burst packets.

ADJUST—C7461 (Normal Multiburst Flatness) for flat multiburst.

f. Disconnect all test equipment if performing only a partial calibration.

GROUP 5—OUTPUT FILTERS

1. Setup

a. Connect all test equipment as given in Group 1, Step 5a, b, c, and d.

b. Set the 147 switches as given in the Preliminary Procedure except, set the FULL FIELD SIG Mode switch to SIN^2 PULSE AND BAR.

c. Set the waveform monitor to view the A Input (FULL FIELD SIGNAL OUT) at a Line .125 H/Cm display rate using external sync and no DC Restoration.

2. Check Output Filters

a. CHECK—2T Pulse amplitude should be 100 IRE within 1 IRE.

b. CHECK—T BAR amplitude should be 100 IRE within 1 IRE.

c. CHECK—Pulse to Bar amplitude ratio should not exceed 1 IRE.

d. Set the waveform monitor Magnifier for X25 magnification.

e. CHECK—Ringing on trailing corner of 2T Pulse should be 0.5 IRE or less.

f. Set the waveform monitor Magnifier switch to Off.

g. For performance check proceed to step 3k.

3. Adjust Output Filters (Calibration Procedure Only)

a. Preset L7110 (2T Pulse Ampl), see Fig. 4-14, for a pulse amplitude of approximately 100 IRE.

b. ADJUST—L7301, L7401, L7501, and L7601 (2T Filter) for the best trailing corner on the 2T Pulse; ringing should be 0.5 IRE or less.

c. ADJUST—L7110 (2T Pulse Ampl) for a pulse amplitude of 100 IRE.

d. Change the connector on pins 5 and 6 (2T) of P7321 to pins 4 and 5 (1T).

e. Change the connector on pins 1 and 2 (2T) of P7131 to pins 2 and 3 (1T).

f. Preset R7131 (1T Pulse Ampl) for a pulse amplitude of approximately 100 IRE.

g. ADJUST—L7311, L7411, L7511, and L7611 (T Filter) for the best trailing corner on the T Pulse; ringing should be 1 IRE or less.

h. ADJUST—R7131 (T Pulse Ampl) for a pulse amplitude of 100 IRE.

i. Change the connector on pins 2 and 3 of P7131 to pins 1 and 2; change the connector on pins 4 and 5 of P7321 to pins 5 and 6.

j. ADJUST—R7143 (Bar Amplitude) for a T Bar amplitude of 100 IRE.

k. Disconnect all test equipment if performing only a partial calibration.

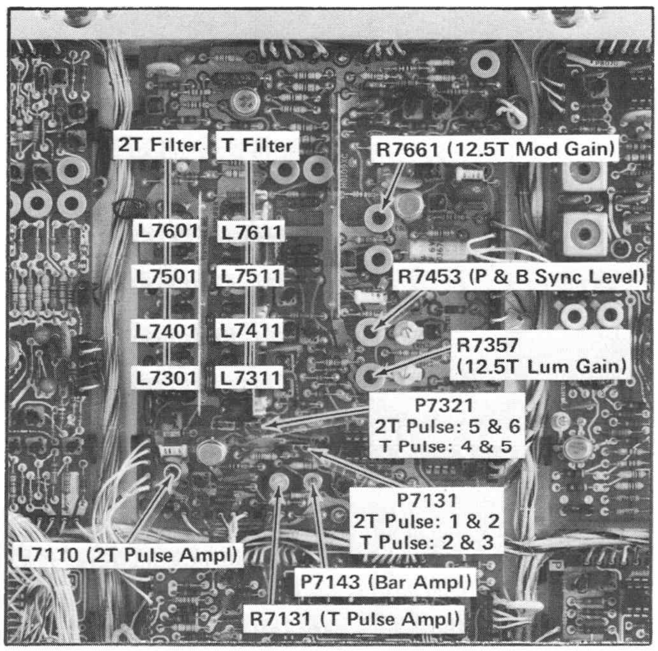


Fig. 4-14. Output Amplifier adjustment and pin connector locations. (Connection between pins 1 and 2 of P7321 produces T Bar; pins 2 and 3 produces 2 T Bar.)

GROUP 6—MODULATED PULSE CHROMA AND VARIABLE PHASE

1. Setup

a. Connect all test equipment as given in Group 1, Step 5a, b, c, and d.

b. Set the 147 switches as given in the Preliminary Procedure, except set the FULL FIELD SIG Mode switch to SIN^2 PULSE AND BAR.

c. Connect the 147 FULL FIELD SIG OUT to the spectrum analyzer.

2. Check/Adjust Subcarrier Harmonics

a. CHECK—Observe the spectrum analyzer display; subcarrier harmonics should be at least 40 dB down.

ADJUST—L8580 (Subcarrier Harmonics), see Fig. 4-15, for minimum harmonics; should be at least 40 dB down.

3. Check/Adjust 12.5T Modulated Pulse Delay

a. Observe the waveform monitor A Input (FULL FIELD TEST SIGNAL OUT) at a Line .125 H/Cm display rate using external sync and no DC Restoration.

b. CHECK—Base of Modulated Pulse should be symmetrical.

ADJUST—L8590 (Modulation Delay), see Fig. 4-15, for a symmetrical base on modulated pulse.

4. Check/Adjust 12.5T Modulated Pulse Amplitude

a. CHECK—Peak of Modulated Pulse should be at 100 IRE within 0.5 IRE of the Bar Amplitude.

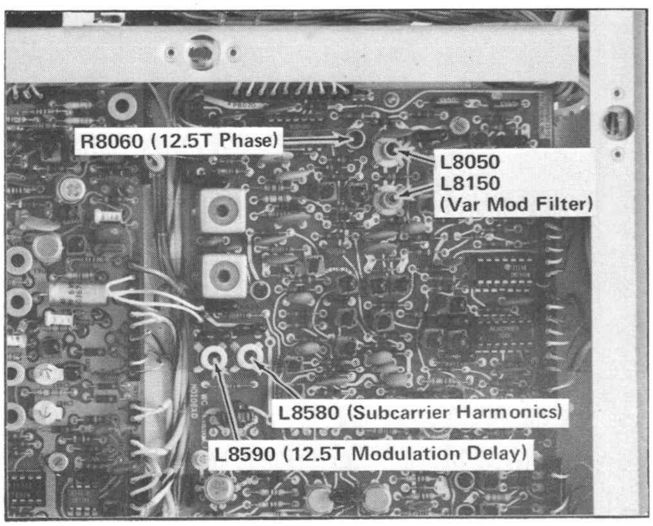


Fig. 4-15. Modulator adjustment locations.

CHECK—Bottom of Modulated pulse should be flat within 1 IRE.

ADJUST—R7661 (Modulation Gain) and R7357 (Luminance Gain), see Fig. 4-14, to obtain a Modulated Pulse with the peak at 100 IRE and a flat bottom.

5. Check/Adjust Sync Level

a. CHECK—Line sync should align with field sync pulses.

ADJUST—R7453 (P & B Sync Level) to align the sync pulses.

6. Adjust 12.5T Modulated Pulse Phase (Calibration Procedure Only)

a. Set R8060 (12.5T Phase), see Fig. 4-15, fully clockwise.

NOTE

This is the only setting of this control.

7. Check/Adjust 12.5T Variable Filter

a. Observe the vector display of the vectorscope CH A Input (FULL FIELD TEST SIGNAL OUT) using external sync and phasing.

b. CHECK—Vectorscope display should appear as a fan shaped circle with an opening of approximately 30 to 60 degrees. This is shown in Fig. 4-16.

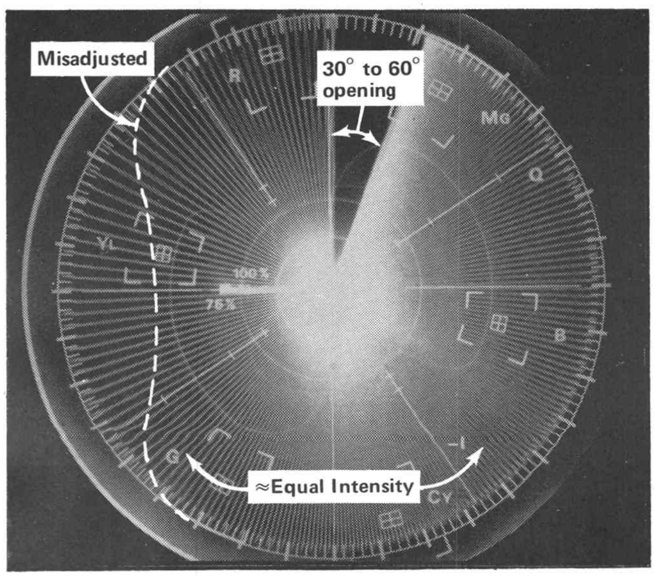


Fig. 4-16. Typical vectorscope display of modulated pulse when variable modulation filters are adjusted.

ADJUST—L8050 and L8150 (Variable Modulation Filters) to obtain the symmetrical display as shown.

c. Disconnect all test equipment if performing only a partial calibration.

GROUP 7—LINEARITY

1. Setup

a. Connect the test equipment as given in Group 1, Step 5a, b, c, and d.

b. Set the 147 switches as given in the Preliminary Procedure, except set the FULL FIELD SIG Mode switch to LINEARITY.

c. Set the waveform monitor to view the A Input (FULL FIELD TEST SIGNAL OUT) at a Line .125 H/Cm display rate, using external sync and no DC Restoration.

2. Check/Adjust Levels

a. CHECK—Staircase should consist of 5 equal levels with the fifth level at 80 IRE within 1 IRE.

ADJUST—C3565 (5 Step Ampl), see Fig. 4-17, to set the fifth level at 80 IRE.

b. Set the 147 LINEARITY Mode switch to 10 STEP.

c. CHECK—Staircase should consist of 10 levels equal within 2% with tenth level at 90 IRE within 1 IRE.

ADJUST—C3470 (10 Step Ampl) to set the tenth level at 90 IRE.

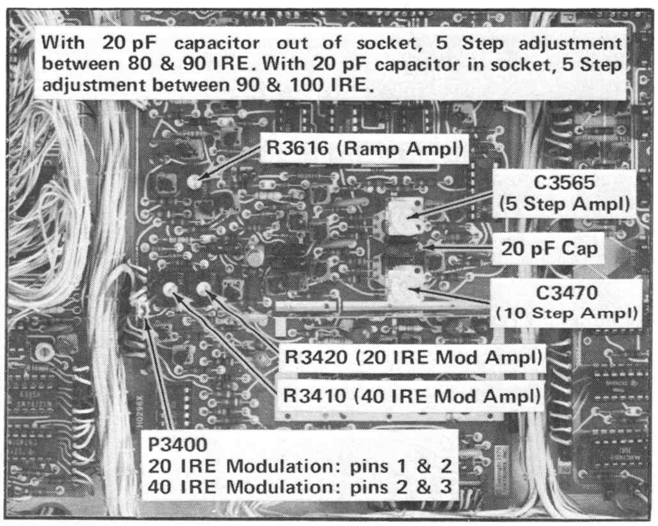


Fig. 4-17. APL Staircase & Noise pin connector, amplitude capacitor, and adjustment locations.

d. Set the 147 LINEARITY Mode switch to RAMP.

e. CHECK—Ramp should be 100 IRE within 1 IRE.

ADJUST—R3616 (Ramp Ampl) for a ramp amplitude of 100 IRE.

3. Check/Adjust Linearity Modulation

a. Set the 147 LINEARITY Mode switch to 5 STEP.

b. CHECK—Modulation should be 40 IRE within 1 IRE.

ADJUST—R3410 (40 IRE Modulation Ampl) for a modulation amplitude of 40 IRE.

NOTE

For Performance Check, proceed to Step 4.

c. Change the connector on P3400 pins 2 and 3 (40 IRE Modulation) and connect it to pins 1 and 2 (20 IRE Modulation).

d. CHECK—Modulation should be 20 IRE within 1 IRE.

ADJUST—R3420 (20 IRE Modulation Ampl) for a modulation amplitude of 20 IRE.

e. Change the connector on P3400 pins 1 and 2 and reconnect it to pins 2 and 3.

4. Check/Adjust Burst Amplitude

a. CHECK—Burst amplitude should be 40 IRE within 1 IRE.

ADJUST—R8620 (Burst Ampl), see Fig. 4-18, for a burst amplitude of 40 IRE.

5. Check/Adjust Burst Filter

a. CHECK—Risetime of burst should be 400 ns within 15%.

ADJUST—L8640 (Burst Filter), see Fig. 4-18, for the best front corner on burst; risetime should be 400 ns within 15%.

6. Check Diff Gain and Diff Phase

a. Set the vectorscope to measure differential gain.

b. CHECK—Diff gain should be 0.5% of less.

c. Set the vectorscope to measure differential phase.

d. CHECK—Diff phase should be 0.2° or less.

e. Disconnect all test equipment if performing only a partial calibration.

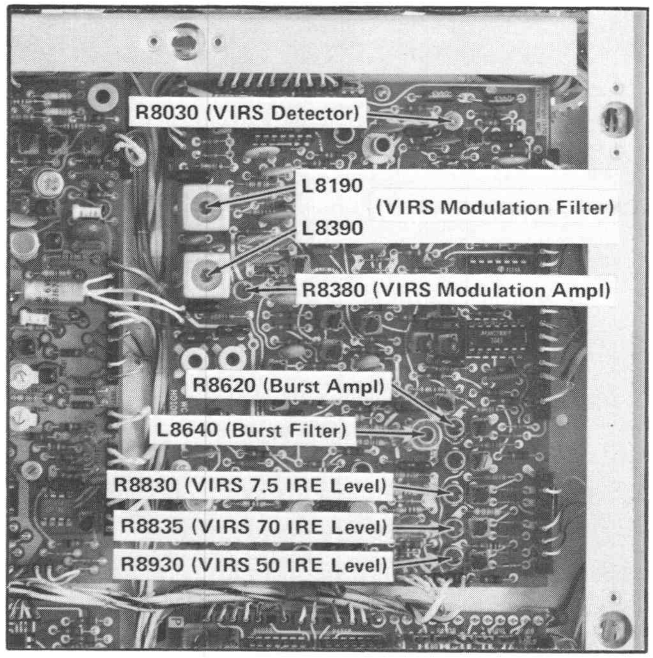


Fig. 4-18. Modulator adjustment locations.

GROUP 8—VIRS

1. Setup

a. Connect all test equipment as given in Group 1, Step 5a, b, c, and d.

b. Set the waveform monitor to view the A Input (FULL FIELD TEST SIGNAL OUT) at a Field .125 H/Cm display rate using external sync and no DC Restoration. Set the Line selector to view line 20.

2. Check/Adjust VIRS Modulation

a. CHECK—VIRS modulation should be 40 IRE within 0.4 IRE.

ADJUST—R8380 (VIRS Modulation Ampl), see Fig. 4-18, for a modulation amplitude of 40 IRE.

3. Check/Adjust VIRS Luminance

a. Using Fig. 4-19 as a guide, CHECK and/or ADJUST those levels shown. Fig. 4-18 shows adjustment locations.

4. Check/Adjust VIRS Modulation Risetime

a. CHECK—VIRS modulation risetime should be 1 μs within 15%.

ADJUST—L8190 and L8390 (VIRS Modulation Filter) for the best front corner; risetime should be 1 μs within 15%.

5. Check/Adjust VIRS Detector

a. Disconnect all test equipment and make the following connections:

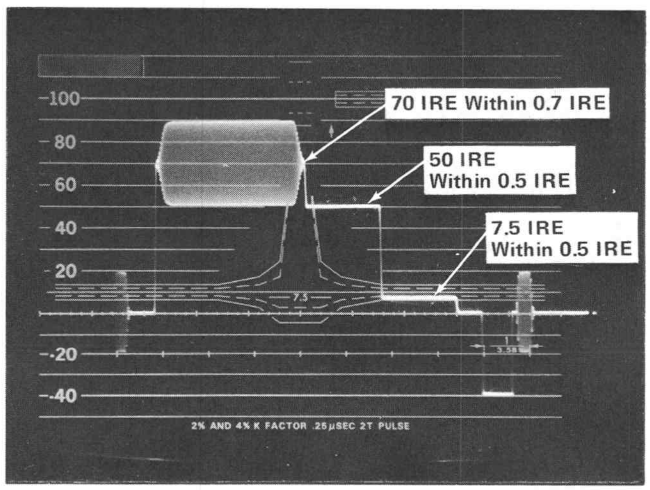


Fig. 4-19. Typical waveform monitor display of VIRS (line 20 of either field).

1. External video source to 147 BLACK BURST IN; terminate loop-thru into 75 Ω. Set 147 rear-panel SYNC SOURCE switch down.

2. 147 rear-panel FULL FIELD TEST SIGNAL OUT to 147 rear-panel PROGRAM LINE IN.

3. 147 rear-panel PROGRAM LINE OUT to waveform monitor A Input; loop-thru terminated into 75 Ω.

b. CHECK—147 front-panel VIRS INCOMING, VIRS INSERT, and VIRS DELETE lamps should all be flickering.

CHECK—Waveform monitor display; VIRS should appear to flicker.

ADJUST—R8030 (VIRS Detector), see Fig. 4-18, to position where all three VIRS indicator lamps are flickering (e.g., with R8030 fully CCW, or CW VIRS INCOMING lamp will be extinguished).

c. Disconnect all test equipment if performing only a partial calibration.

GROUP 9—VIT ADDER

NOTE

Before proceeding with the checks and adjustments for the VIT Adder, Instrument Return Loss might be checked or adjusted. This procedure is not required, but is included for those who desire it. The instrument has been calibrated at the factory for a Return Loss of at least 40 dB, which should not require further adjustment.

Instrument Return Loss

1. Connect one of two matched 75 Ω terminations to the 015-0149-00 Calibration Fixture Reference coaxial cable, then connect the calibration fixture to the A and B Inputs of a Differential Amplifier.

2. From a Constant Amplitude Signal Generator, apply a 50 kHz sinewave via a 50 Ω to 75 Ω minimum loss attenuator, to the input connector on the Calibration Fixture.

3. Set the Differential Amplifier for a vertical deflection of .1 volts/div with both inputs AC Coupled, set to A-B. The test oscilloscope should be set for a free running sweep at .1 ms/div.

4. While observing the display (1 Input), set the signal generator output for a peak to peak signal amplitude of 500 mV. Then, set the Differential Amplifier to differentially display both inputs at a vertical deflection factor of 1 mV/div. Connect the other matched 75 Ω termination to the Unknown coaxial cable on the calibration fixture. Set the signal generator to 5 MHz.

5. Check—Amplitude of display should be 1 mV or less.

NOTE

This insures the calibration fixture is operating properly.

6. Set the 147 POWER switch OFF.

7. Remove the 75 Ω termination from the Unknown coaxial cable, and connect it to the 147 PROGRAM LINE OUT. Connect the Unknown coaxial cable to the 147 PROGRAM LINE IN.

8. CHECK—Amplitude of display should be 5 mV peak to peak or less (40 dB).

ADJUST—C560 and C580 (Return Loss) see Fig. 4-22, for Instrument Return Loss of 40 dB or greater.

9. Set the 147 POWER switch ON.

10. Disconnect all test equipment if performing only a partial calibration.

1. Setup

a. Connect all test equipment as given in Group 1, Step 5a, b, c, and d, except use 147 PROGRAM MONITOR OUT in place of FULL FIELD TEST SIGNAL OUT.

b. Set the 147 switches as given in the Preliminary Procedure.

c. Set the waveform monitor to view the A Input PREVIEW MONITOR OUT (PROGRAM MONITOR out SN B070000 and below) at a Line .25 H/Cm display rate using X5 Magnification, external sync, and no DC Restoration.

rate using X5 Magnification, external sync, and no DC Restoration.

NOTE

To properly check the VIT ADDER, internal VIT LINE and VIT FIELD changes must be made. The following steps should therefore be performed by personnel familiar with the various VIT signals.

d. Program the various VIT signals generated by the 147 as described below. Refer to the Operating Instructions of this manual for details.

1. All VITS for VIELD 1 (include VIRS).

2. NOISE—Line 16; MULTIBURST—Line 17; COMPOSITE—Line 18; SPARE 1, SIN^2 PULSE AND BAR; SPARE 2, External—Line 21.

NOTE

VIRS will appear on Line 20 Only.

2. Check/Adjust Auxiliary Sync

a. Observing the waveform monitor display, set the 147 PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch to AUXILIARY and the AUXILIARY PEDESTAL control fully clockwise.

b. CHECK—Display should appear as shown in Fig. 4-20(A). Fig. 20(B) shows incorrect adjustment.

ADJUST—R7361 (Auxiliary Sync Level), see Fig. 4-21, to align the display as shown in Fig. 4-20(A).

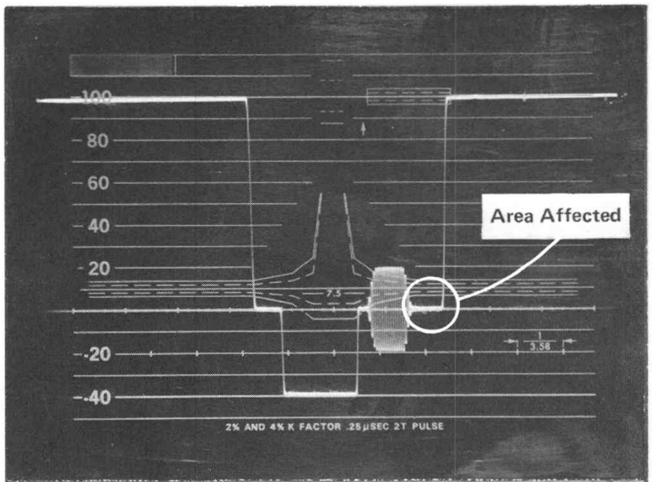
3. Check/Adjust Program DC Level

a. Disconnect the 147 PROGRAM MONITOR OUT and connect the PROGRAM LINE OUT.

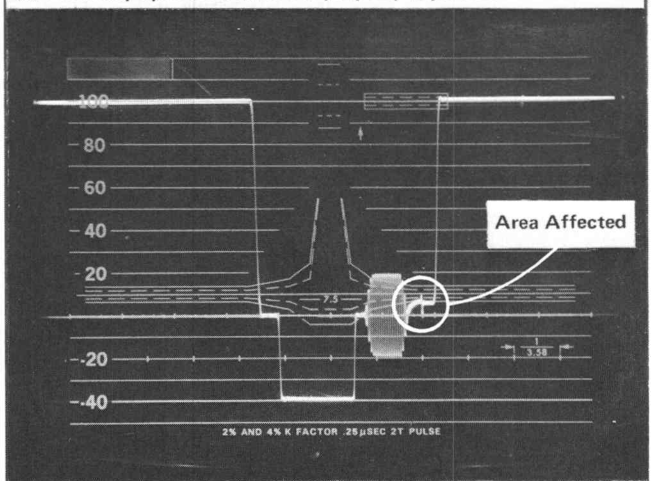
b. Set the waveform monitor for a Field .125 H/Cm display rate with no magnification. Select line 16 for an alternate display (e.g., set the waveform monitor Field switch between Field 1 and Field 2 position).

c. Set the external video source to provide a staircase VIT on line 16 of field 2.

d. Observing the waveform monitor display, rotate the Vertical Position control to align the blanking level with the



(a) Auxiliary sync level (R7361) properly adjusted.



(b) Auxiliary sync level (R7361) misadjusted.

Fig. 4-20. Typical waveform monitor display used to check or adjust auxiliary sync level.

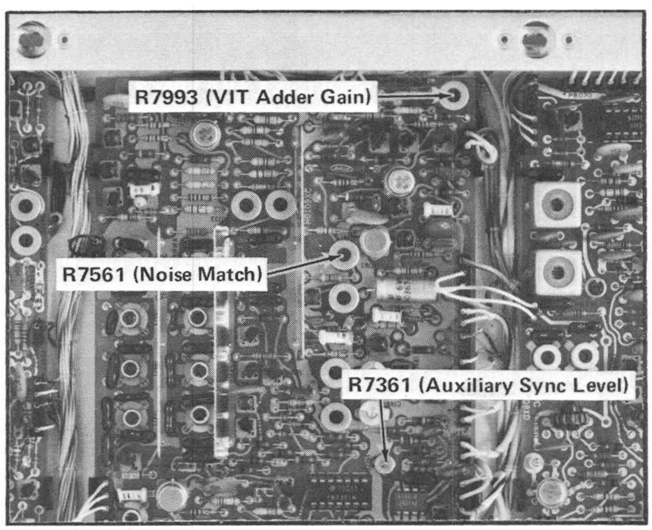


Fig. 4-21. Output Amplifier adjustment locations.

0 IRE graticule line. DO NOT MOVE THIS CONTROL UNTIL THE COMPLETION OF THIS STEP.

e. Set the 147 PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch to PREVIEW.

f. CHECK—Blanking level of display should be at 0 IRE, within 50 mV.

ADJUST—R785 (Program DC Level), see Fig. 4-22, to align the blanking level at 0 IRE. Repeat the adjustment as necessary until there is minimum DC shift between Auxiliary and Preview.

4. Check/Adjust Program Sync Level

a. Set the 147 PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch to PROGRAM.

b. CHECK—Blanking levels of both displays should be aligned.

ADJUST—R775 (Program Sync Level), see Fig. 4-22, to align the blanking levels.

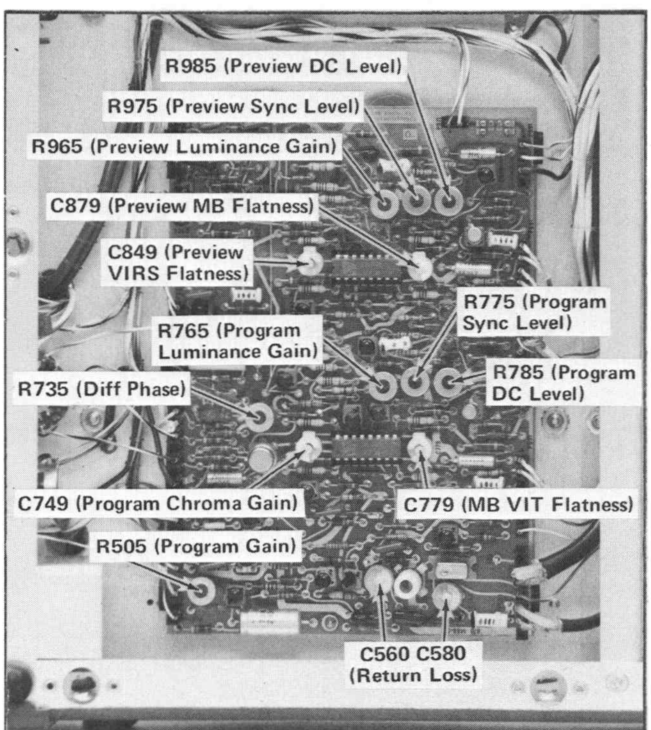


Fig. 4-22. VIT Adder adjustment locations.

5. Check/Adjust Program Gain

a. CHECK—100 IRE level of the external staircase signal should align with the 100 IRE level of the 147 NOISE signal.

ADJUST—R505 (Program Gain), see Fig. 4-22, to align the 100 IRE levels.

6A. Check/Adjust Program Luminance Gain

a. Observing the waveform monitor display, switch the 147 PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY between PREVIEW and AUXILIARY.

b. CHECK—There should be no luminance amplitude change as the switch positions are changed.

ADJUST—R765 (Program Luminance Gain), see Fig. 4-22, to remove any change as the switch is changed between AUXILIARY and PREVIEW.

6B. Adjust Program Bandwidth (SN B070528-up)

a. Connect the 147 PROGRAM LINE OUT to the test oscilloscope via a 75 Ω coaxial cable and 75 Ω termination.

b. Set the test oscilloscope for a vertical deflection of 5 mV/division, DC coupled at a sweep rate of 5 μs/division using internal triggering.

c. Connect composite video or black burst to the 147 BLACK BURST input connector via a 75 Ω coaxial cable and set the SYNC SOURCE switch down.

d. Observing the test oscilloscope display, adjust R895 (Program Bandwidth) for minimum transient amplitude.

NOTE

This adjustment will affect Pulse-To-Bar Ratio (see calibration procedure).

e. Disconnect all connections made in this step and continue with step 7.

7. Check/Adjust Multiburst VIT Flatness

a. Set the waveform monitor to view line 17. (Continue to use alternate fields.)

b. CHECK—Multiburst should be flat within 1 IRE.

ADJUST—C779 (Multiburst VIT Flatness), see Fig. 4-22 for no tilt of the multiburst VIT.

8. Check/Adjust Program Chroma Gain

a. Set the waveform monitor for a 2 Line display rate.

b. Observing the waveform monitor display, switch the 147 PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch between PREVIEW and AUXILIARY.

c. CHECK—Chrominance amplitude should remain unchanged as the switch is changed.

ADJUST—C749 (Program Chroma Gain), see Fig. 4-22, to remove any change in chroma as the switch is changed.

9. Check/Adjust Differential Phase and Gain

a. Set the external video source to provide a 5 Step Staircase composite video signal. (If using the Type 140, set the Video switch down.)

b. Set the 147 PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch to PROGRAM.

c. Set the vectorscope to measure differential phase.

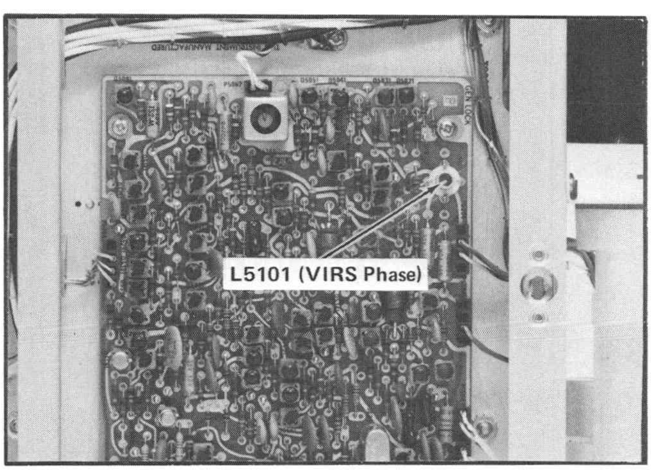


Fig. 4-23. Gen-Lock adjustment location.

d. CHECK—Differential phase should be 0.15° or less in either the (+) or (−) direction.

ADJUST—R735 (Diff Phase), see Fig. 4-22, for minimum differential phase; should be 0.15° or less.

e. Set the vectorscope to measure differential gain.

f. CHECK—Differential gain should be 0.2% or less.

g. Set the vectorscope for a vector display.

10. Check/Adjust VIRS Phase

a. Set the vectorscope to view line 20 VITS. (See vectorscope instruction manual for details.)

b. Observing the vectorscope display, rotate the 147 front-panel INSERT SUBCARRIER PHASE control to superimpose the burst and VIR vector.

c. CHECK—Range of INSERT SUBCARRIER PHASE should be greater than 3°.

ADJUST—Center the INSERT SUBCARRIER PHASE control. Adjust L5101 (VIRS Phase), see Fig. 4-23, to superimpose the burst and VIR vectors. Repeat the CHECK portion of this step before continuing.

11. Check/Adjust Preview DC Level

a. Set the 147 PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch to PROGRAM.

b. Set the waveform monitor to view line 17 of both fields (alternate display). Use a Field .125 H/Cm display rate.

c. Observing the waveform monitor display of the multiburst VIT, position the blanking level of the display to the 0 IRE graticule line. DO NOT MOVE THE POSITION CONTROL UNTIL THE COMPLETION OF THIS STEP.

d. Disconnect the PROGRAM LINE OUT and connect the PREVIEW MONITOR OUT.

e. CHECK—Blanking level of display should be at the 0 IRE graticule line.

ADJUST—R985 (Preview DC Level), see Fig. 4-22, to position the blanking level to the 0 IRE graticule line.

12. Check/Adjust Preview Sync Level

a. CHECK—Observe the display just following burst; both displays should align. (Area to check is similar to that shown in Fig. 4-20.)

ADJUST—R975 (Preview Sync Level), see Fig. 4-22, to align the displays.

13. Check/Adjust Preview Gain

a. CHECK—Peak to peak amplitude of the display should be 140 IRE between sync tip and the pedestal.

ADJUST—R965 (Preview Gain) see Fig. 4-22, for a peak to peak amplitude of 140 IRE.

14. Check/Adjust Preview Multiburst Flatness

a. Set the waveform monitor to view line 17.

b. Multiburst should be flat at 100 IRE within 1 IRE.

ADJUST—C879 (Preview Multiburst Flatness), see Fig. 4-22 for no tilt.

15. Check/Adjust Preview Flatness

a. Set the vectorscope for a vector display of line 20 (VIRS).

b. CHECK—Burst and VIR vectors should be superimposed.

ADJUST—C849 (Preview Flatness), see Fig. 4-22, to superimpose the burst and VIR vectors.

16. Check/Adjust External VIT Adder Gain

a. Disconnect the PROGRAM LINE IN; install a BNC-T adapter and reconnect the PROGRAM LINE IN. From the BNC-T, connect to the 147 rear-panel EXT VIT IN.

b. Set the external video source to provide a color bar VIT on line 21 of field 1.

c. Set the waveform monitor to view line 21 at a Field .125 H/Cm display rate; set the Field switch to view alternate fields.

d. CHECK—Displays should be superimposed within 1 IRE.

ADJUST—R7993 (Ext VIT Gain), see Fig. 4-21, to superimpose the displays.

17. Check/Adjust Noise Amplitude

a. From the 147 NOISE OUT, in order, connect the 015-0213-00 Calibration Fixture, 75 Ω feed-thru termination, and the RMS Voltmeter.

b. CHECK—Noise amplitude should be 70 mV RMS within 1%.

ADJUST—R3270 (Noise Bandwidth), see Fig. 4-24, fully clockwise; R3260 (Noise Ampl) for 70 mV RMS.

NOTE

R3270 fully clockwise is the only setting of this control.

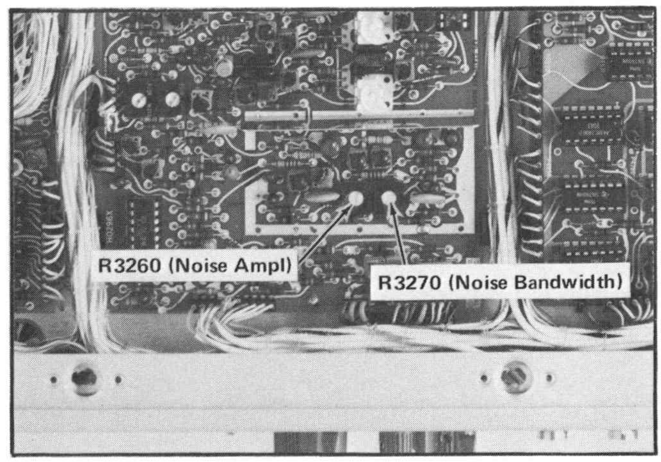


Fig. 4-24. APL Staircase and Noise adjustment locations.

18. Check Noise Spectrum

a. Disconnect the 147 NOISE OUT; connect a Spectrum Analyzer to the NOISE OUT.

b. CHECK—Noise spectrum; should be flat to 5 MHz within 6 dB.

19. Check/Adjust Insertion Noise Gain

a. Disconnect all test equipment and make the following connections:

1. External video signal to 147 BLACK BURST IN; terminate the other BLACK BURST IN (loop-thru) into 75 Ω.

2. External composite sync to waveform monitor Ext Sync In; terminate the other Ext Sync In (loop-thru) into 75 Ω.

3. 147 PREVIEW MONITOR OUT to waveform monitor A Input; terminate the other A Input (loop-thru) into 75 Ω.

4. 147 NOISE OUT to rear-panel PROGRAM LINE IN.

b. Set the waveform monitor to view the A Input at a 2 Line display rate, using external sync and no DC restoration.

c. Set the 147 NOISE switch to INSERTION, PEDESTAL switch to 0 IRE, NOISE LEVEL dB switches to 25 dB (any setting to provide noise), FULL FIELD SIG Mode switch to NOISE, PROGRAM CONTROL PROGRAM/PREVIEW/AUXILIARY switch to PREVIEW, and the rear-panel SYNC SOURCE switch down.

d. Observing the waveform monitor display, rotate the NOISE VAR control to align the inserted noise signal with the continuous noise signal.

e. CHECK—Inserted noise peak to peak amplitude should match peak to peak amplitude of continuous noise.

ADJUST—R7561 (Noise Match), see Fig. 4-21, to match the two noise signals.

f. Disconnect all test equipment if only a partial calibration is being performed.

GROUP 10—TIMING

1. Setup

a. From the 147 FULL FIELD TEST SIGNAL OUT, connect to the waveform monitor A Input; from the other A Input (loop-thru) connect to the vectorscope CH A Input; terminate the other CH A Input (loop-thru) into 75 Ω.

b. Connect an external 1 volt peak to peak composite video signal to the waveform monitor B Input; from the other B Input (loop-thru) connect to the 147 PROGRAM LINE IN.

c. Connect an external composite sync signal to the waveform monitor Ext Sync Input; terminate the other Ext Sync Input (loop-thru) into 75 Ω.

d. Connect an external subcarrier (3.579545 MHz) signal to the vectorscope Ext ϕ Ref; terminate the other Ext ϕ Ref (loop-thru) into 75 Ω.

e. Set the 147 switches as given in the Preliminary Procedure.

f. Set the waveform monitor to view the A Input (FULL FIELD TEST SIGNAL OUT) at a Field .25 H/Cm display rate, Line Selector to Variable, Field switch to Field 2, and use external sync and no DC Restoration.

2. Check/Adjust Timing

a. Observing the waveform monitor display, rotate the Variable Line Selector to view the last equalizing pulse and the first line sync pulse of field 2. This is shown in Fig. 4-25(A).

b. Set the waveform monitor to view the B Input (external video). The display should be similar to that obtained in part a.

c. Set the waveform monitor to view the A and B Inputs differentially (A minus B). The display should be as shown in Fig. 4-25(B) (1), (2), or (3).

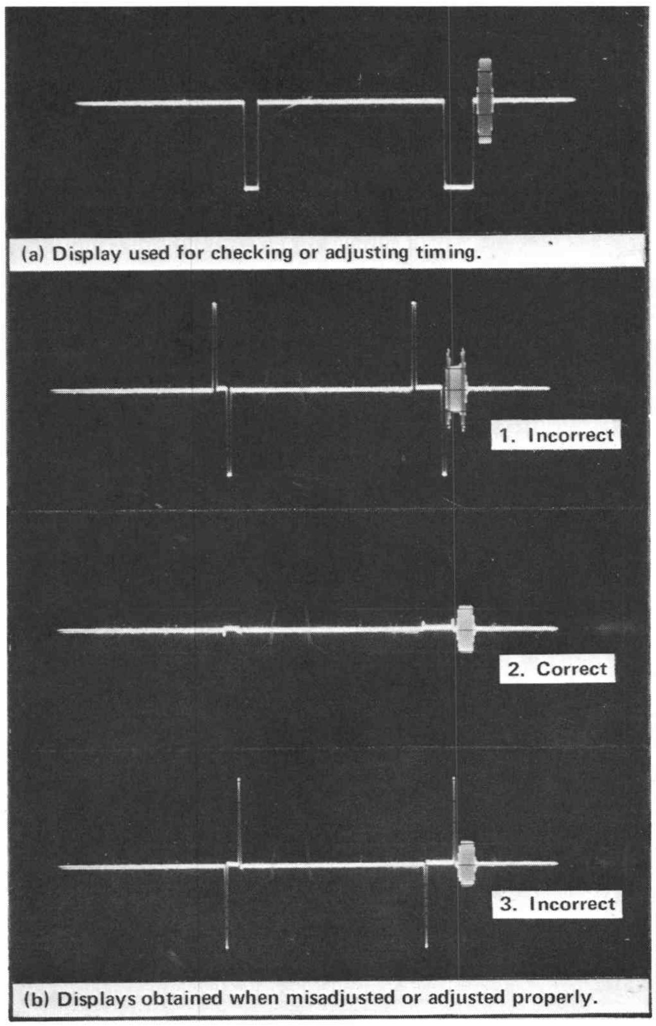


Fig. 4-25. Typical waveform monitor display obtained when checking or adjusting timing.

d. CHECK—leading edges of line sync pulses should be nulled.

ADJUST—R1988 (Sync Delay), see Fig. 4-4, to null the leading edges of line sync. (This control was preset earlier in the procedure.)

e. CHECK—Trailing edges of line sync should be nulled.

ADJUST—R250 (Sync Width), see Fig. 4-26, to null the trailing edges of line sync.

f. CHECK—Equalizer pulses should be nulled.

ADJUST—R150 (Equalizer Width) to null the equalizer pulses.

g. Rotate the waveform monitor Variable Line Selector to view the serration pulses.

h. CHECK—Serration pulses should be nulled.

ADJUST—R350 (Serration Width) to null the serration pulses.

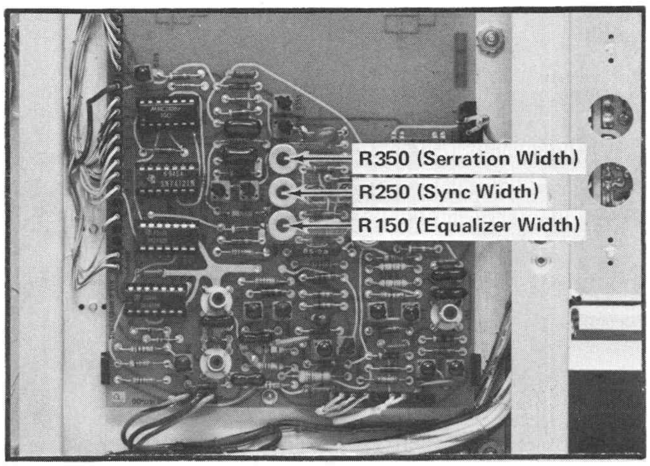


Fig. 4-26. Subcarrier & Sync adjustment locations.

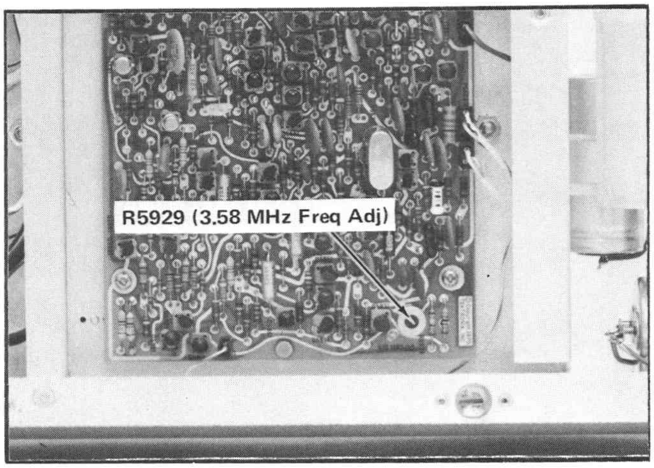


Fig. 4-27. Gen-Lock adjustment location.

3. Check/Adjust 3.58 MHz

a. Set the vectorscope for a vector display of the CH A Input using external phase reference. A stable vector (locked) representing burst will be observed.

b. Set the external video source to remove the burst on the composite video signal being applied to the 147 PROGRAM LINE IN. (If using the type 140, set the Burst switch down.)

c. CHECK—Vectorscope display; vector rotation should be below eye flicker rate.

ADJUST—R5929 (3.58 MHz Freq Adj), see Fig. 4-27, for minimum rotation of vector.

This completes the Performance Check/Calibration of the 147. Re-program the 147 VITS as follows: MULTI-BURST, Line 18 of Field 1; NOISE, Line 18 of Field 2; COMPOSITE, Line 19 of Field 1; LINEARITY, Line 19 of Field 2; VIRS, Line 20 of Both Fields.

SECTION 5
RACKMOUNTING

RACKMOUNTING INSTRUCTIONS

Mounting Methods (Figs. 5-1, 5-2, 5-5 and 5-6)

The instruments will fit most commercial consoles and most 19-inch wide racks whose front and rear rail holes conform to Universal, EIA, RETMA and Western Electric hole spacing.

Fig. 5-1 shows the instrument installed in a cabinet type rack with 1 3/4-inch wide slide-out tracks for a non-tilt installation. The instrument is secured into the rack by means of four captive thumb screws. When the thumb screws on the front panel are loosened, the instrument can be pulled out of the rack like a drawer to its fully extended position (see Fig. 5-2). This position permits many routine maintenance functions to be performed without completely removing the instrument from the rack.

The slide-out tracks easily mount to the cabinet rack front and rear vertical mounting rails if the inside distance between the front and rear rails is within 10 1/2 to 24 1/2 inches. Some means of support (for example, make extensions for the rear mounting brackets) is needed for the rear ends of the slide-out tracks if the tracks are going to be installed in a cabinet rack whose inside dimension between front and rear rails is not the proper distance (10 1/2 inches to 24 1/2 inches).

Instrument Dimension

The last page in this section shows dimensional drawings exclusive of the power cord and cables.

Width—A standard 19-inch rack may be used. The dimension or opening between the front rails must be at least 17 5/8 inches (see Fig. 5-2) for a cabinet rack in which the front lip of the stationary section is mounted behind an untapped front rail as shown in the right-hand illustration of Fig. 5-6. This dimension allows room on each side of the instrument for the slide-out tracks to operate so the instrument can move freely in and out of the rack.

Depth—For proper circulation of cooling air, allow at least 2 inches clearance behind the rear of the instrument and any enclosure on the rack (see dimensional drawing). If it is sometimes necessary or desirable to operate the generator in the fully extended position, use cables that are long enough to reach from the instrument to the location where the signal(s) is to be applied.

Rackmounting in a Cabinet Rack

General Information—The slide-out-tracks for the instrument consists of two assemblies, one for the left side of the instrument and one for the right side. Each assembly consists of three sections as illustrated in Fig. 5-3. The stationary section attaches to the front and rear rails of the rack with inside dimensions as indicated in Fig. 5-2; the chassis section attaches to the instrument and is installed at the factory; the intermediate section fits between the other two sections to allow the instrument to be fully extended out of the rack.

The small hardware components included with the slide-out track assemblies are shown in Fig. 5-4. The hardward shown in Fig. 5-4 is used to mount the slide-out tracks to the rack rails having this compatibility.

(a) Front and rear rail holes must be large enough to allow inserting a 10-32 screw through the rail mounting holes (see Fig. 5-6).

(b) Front rail holes may have already been countersunk prior to this installation.

Because of the compatibility given in (b), there will be some screws left over.

The stationary and intermediate sections for both sides of the rack are shipped as a matched set and should not be separated. The matched sets for both sides including hardware are marked 351-0195-00 on the package. To identify the assemblies, note that the automatic latch and intermediate section stop are located near the top of the matched sets when they are properly mated to the chassis sections as shown in Fig. 5-3.

Mounting Procedure—Use the following procedure to mount both sets. See Fig. 5-5 and 5-6 for installation details.

1. To mount the instrument directly above or below another instrument in the cabinet rack, select the appropriate holes in the front rack rails for the stationary sections using Fig. 5-5 as a guide.

2. Mount the stationary slide-out track sections to the front rack rails using either of these methods:

(a) If the front rails are not countersunk, use the pan head screws and bar nuts to mount the stationary sections similar to the right-hand illustration shown in Fig. 5-6.

(b) If the front rails are countersunk, use the flat head screws and bar nuts to mount the stationary sections as shown in Fig. 5-6 right-hand illustration.

3. Mount the stationary slide-out track sections to the non-tapped rear rails using this method:

Mount the left stationary section with hardware provided as shown in the left-hand or center illustration in Fig. 5-6. Note that the rear mounting bracket can be installed either way so the slide-out tracks will fit a deep or shallow cabinet rack. Use Fig. 5-6 as a guide for mounting the right stationary section. Make sure the stationary sections are horizontally aligned so they are level and parallel with each other.

Adjustments

To adjust the slide-out tracks for smooth operation, proceed as follows:

1. Insert the instrument into the rack as described and as shown in steps 1 through 4 of Fig. 5-7 installation procedure.

2. Adjust the slide-out tracks for proper spacing as shown in Fig. 5-8.

Maintenance

The slide-out tracks require no lubrication. The special dark gray finish on the sliding parts is a permanent lubrication.

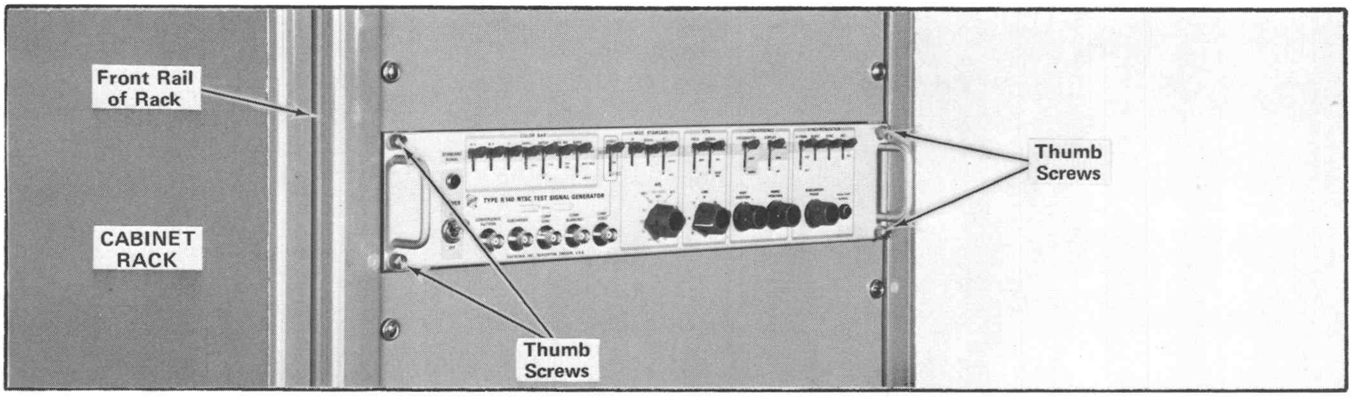


Fig. 5-1. The generator installed in a cabinet rack.

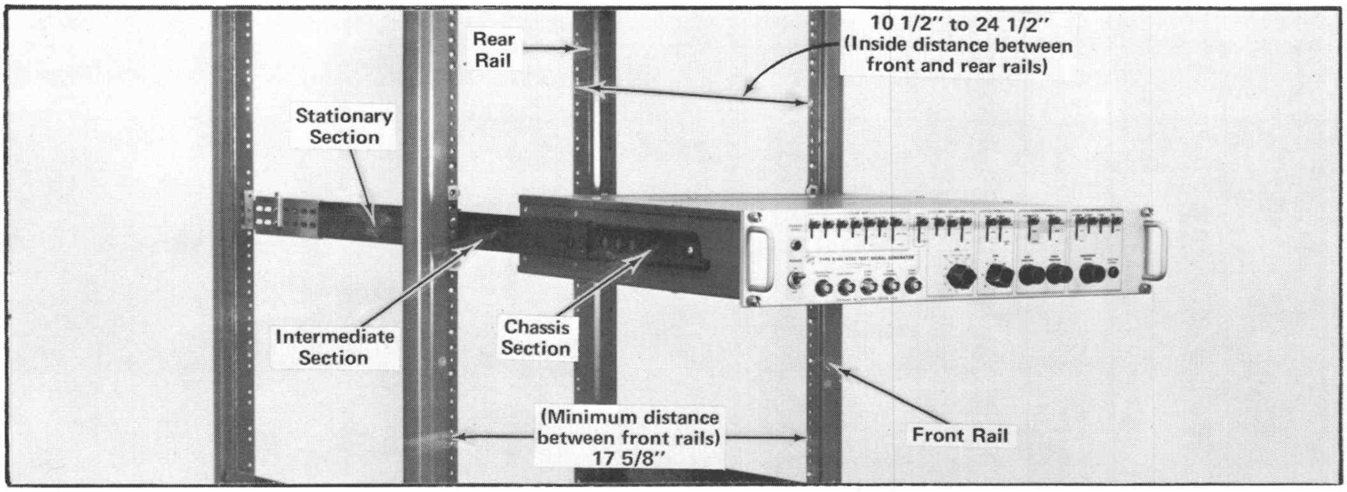


Fig. 5-2. The generator shown in the fully extended position. The cabinet rack sides have been removed from the rack to show mounting.

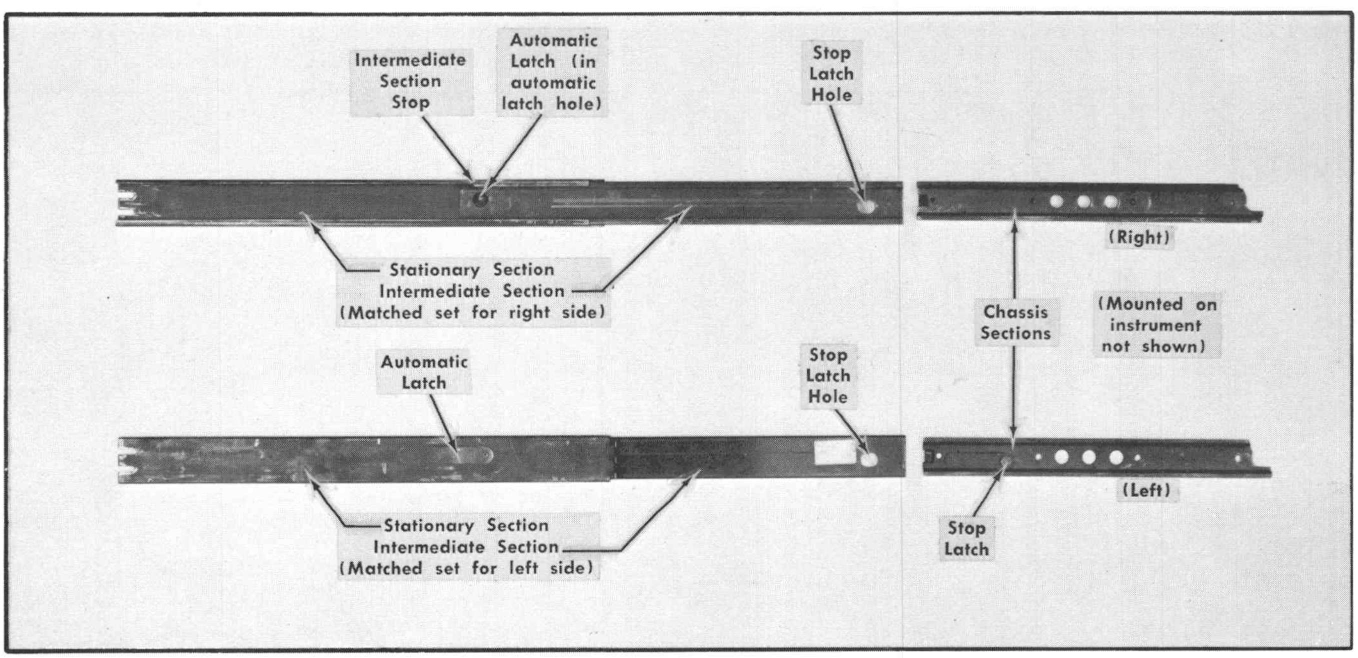


Fig. 5-3. Illustration showing the 1 3/4-inch wide slide-out track assemblies.

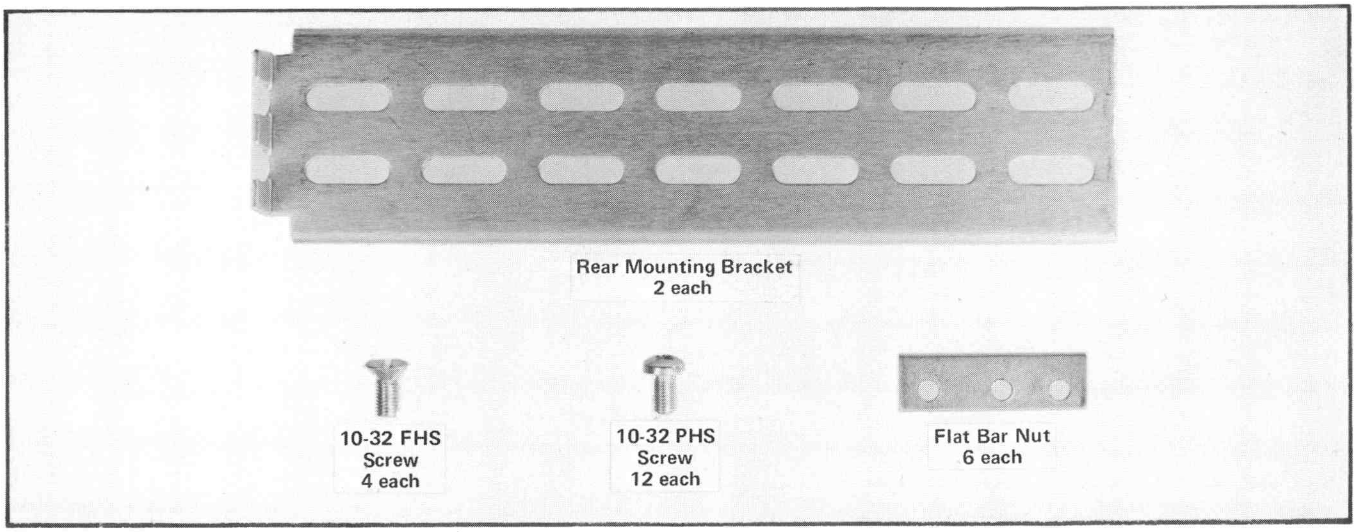


Fig. 5-4. Small hardware components for mounting the stationary sections to the rack rails.

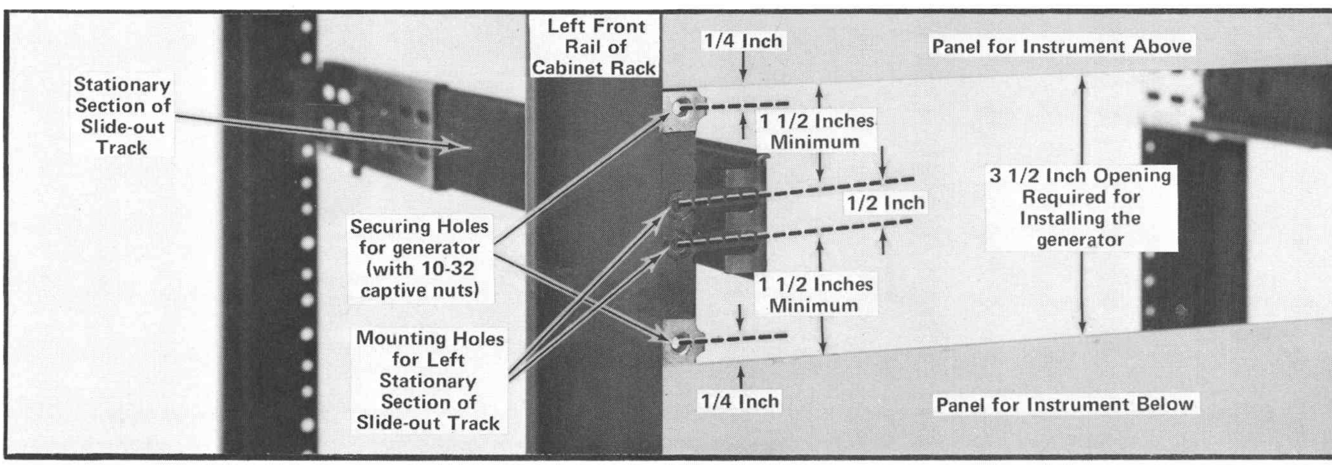


Fig. 5-5. Vertical mounting position of the left stationary section and location of the securing holes. These same dimensions apply to the right front rail.

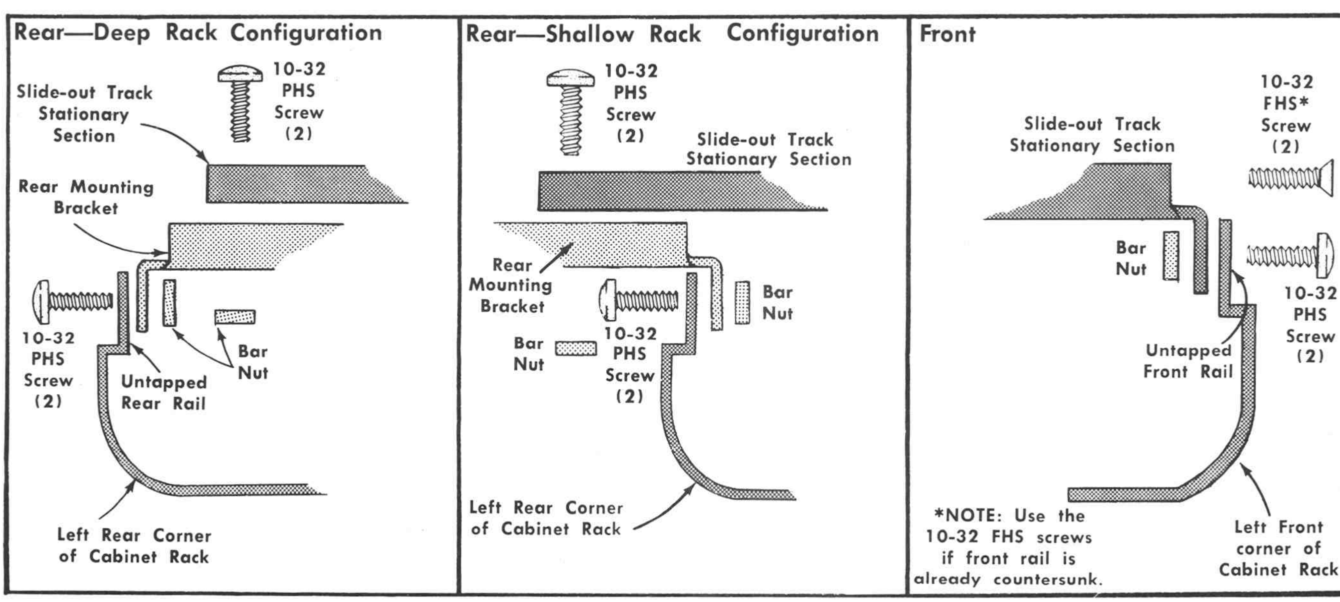


Fig. 5-6. Top view of cabinet rack showing mounting position of the left stationary section to the rails of the rack. Since the rails are not tapped, bar nuts are used to mount the stationary section to the rack rails.

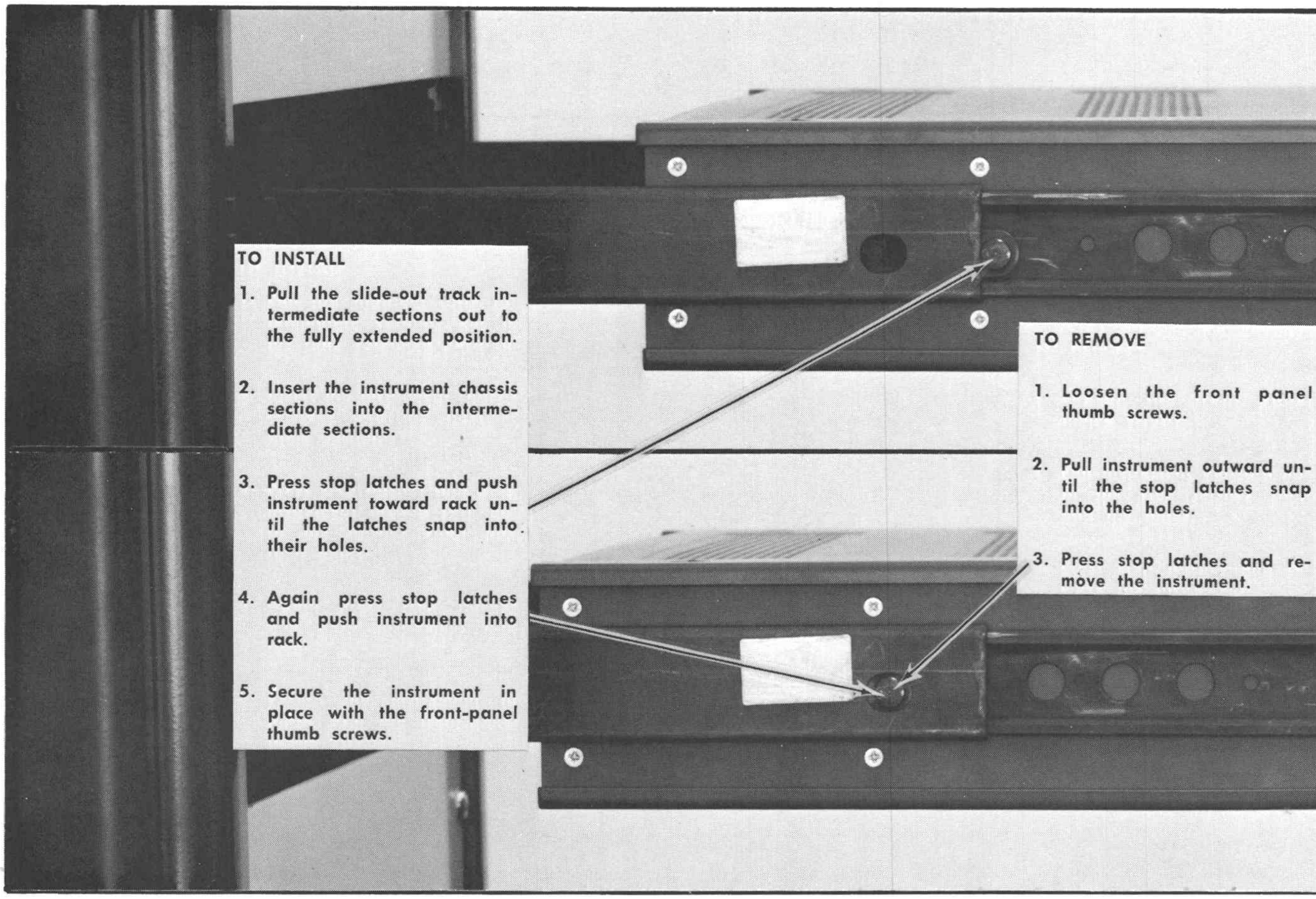


Fig. 5-7. Installing and removing the instrument.

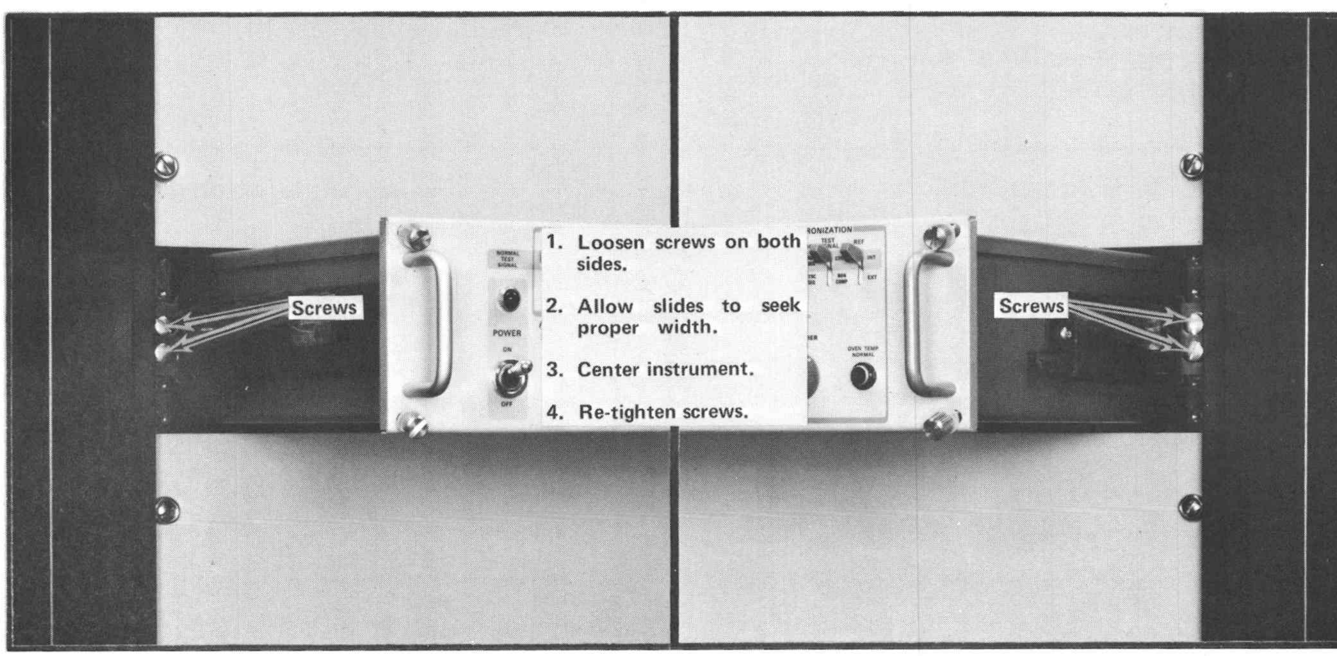
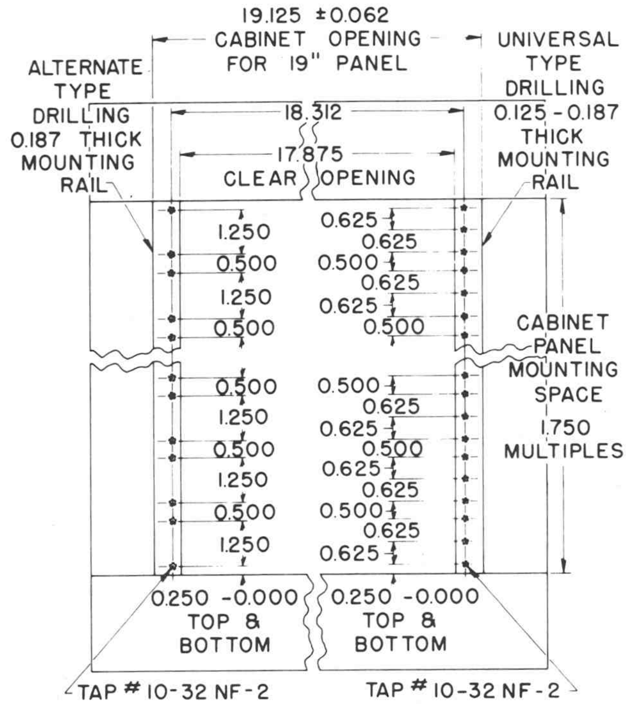
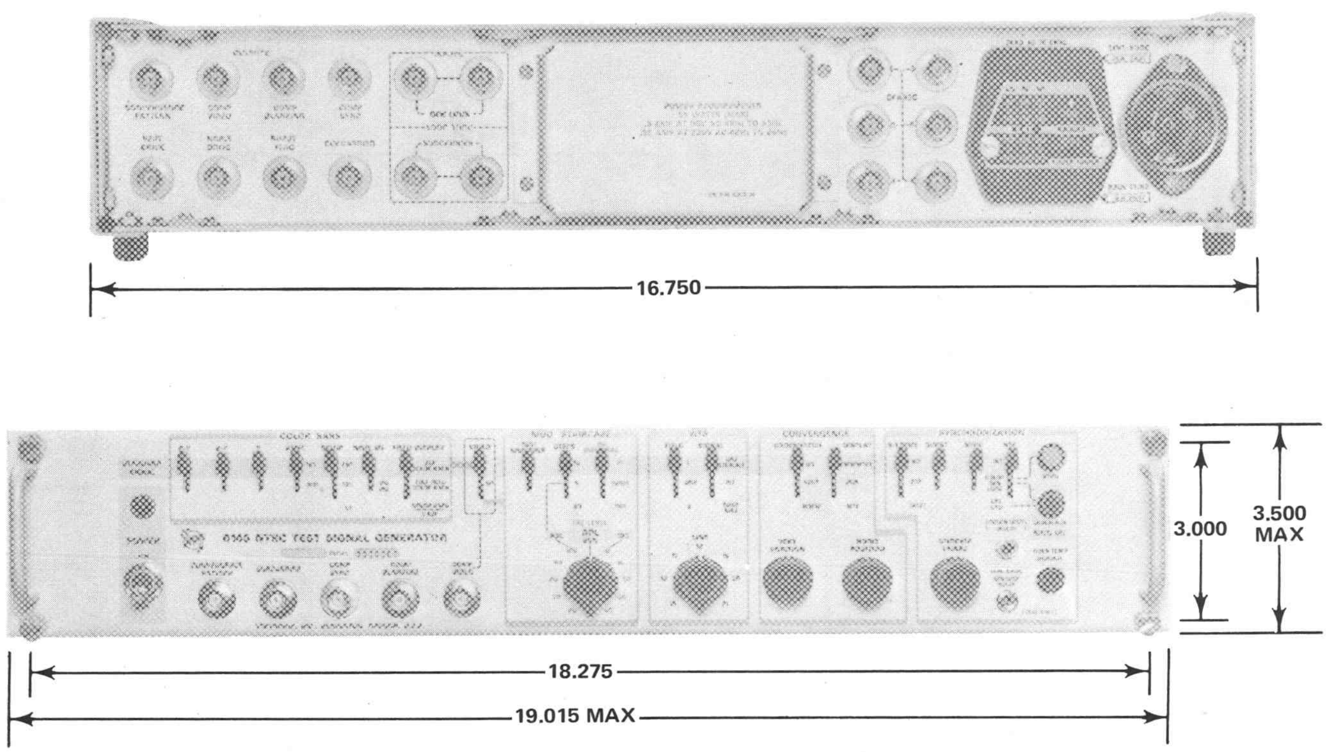


Fig. 5-8. Adjusting the slide-out tracks for smooth sliding action.

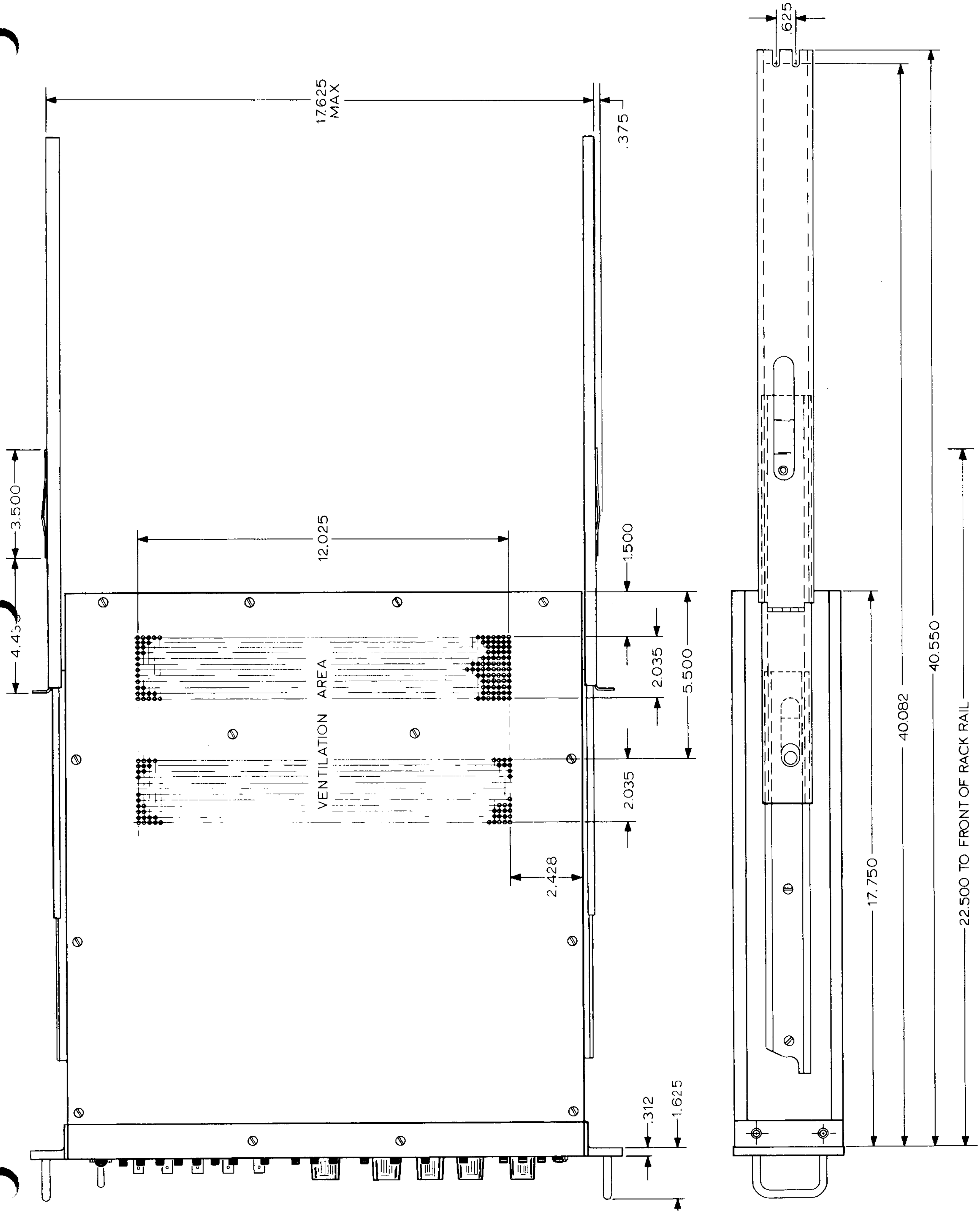
RACK RAIL TYPES





Dimensional Drawing

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Dimensional Drawing

SECTION 6
ELECTRICAL PARTS LIST

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS AND REFERENCE DESIGNATORS

A	Assembly, separable or repairable
AT	Attenuator, fixed or variable
B	Motor
BT	Battery
C	Capacitor, fixed or variable
Cer	Ceramic
CR	Diode, signal or rectifier
CRT	cathode-ray tube
DL	Delay line
DS	Indicating device (lamp)
Elect.	Electrolytic
EMC	electrolytic, metal cased
EMT	electrolytic, metal tubular
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, etc.)
HR	Heater
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
Q	Transistor or silicon-controlled rectifier
P	Connector, movable portion
PMC	Paper, metal cased
PT	paper, tubular
PTM	paper or plastic, tubular molded
R	Resistor, fixed or variable
RT	Thermistor
S	Switch
T	Transformer
TP	Test point
U	Assembly, inseparable or non-repairable
V	Electron tube
Var	Variable
VR	Voltage regulator (zener diode, etc.)
WW	wire-wound
Y	Crystal

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
ASSEMBLIES				
A0	670-1468-00	B010100	B060000	VIT INSERTION Circuit Board Assembly
A0	670-1468-01	B070000		VIT INSERTION Circuit Board Assembly
A1	670-1472-00			VERT COUNTER Circuit Board Assembly
A2	670-1471-00			HORIZ TIMING Circuit Board Assembly
A3	670-1474-00			APL STAIRCASE & NOISE Circuit Board Assembly
A4	670-1469-00			VIT & FULL FIELD Circuit Board Assembly
A5	670-1487-00			GENLOCK Circuit Board Assembly
A6	670-1470-00	B010100	B019999	FUNCTION GEN Circuit Board Assembly
A6	670-1470-01	B020000		FUNCTION GEN Circuit Board Assembly
A7	670-1476-00	B010100	B019999	OUTPUT AMP Circuit Board Assembly
A7	670-1476-01	B020000		OUTPUT AMP Circuit Board Assembly
A8	670-1475-00	B010100	B019999	MODULATOR Circuit Board Assembly
A8	670-1475-01	B020000	B049999	MODULATOR Circuit Board Assembly
A8	670-1475-02	B050000		MODULATOR Circuit Board Assembly
A9	670-1477-00			SUBCARRIER & SYNC Circuit Board Assembly
A10	670-1473-00	B010100	B039999	POWER SUPPLY Circuit Board Assembly
A10	670-1473-01	B040000		POWER SUPPLY Circuit Board Assembly
A11	670-2327-00	XB070000		RELAY & DELAY Circuit Board Assembly
CAPACITORS				
C22	283-0596-00			528 pF, Mica, 300 V, 1%
C24	283-0602-00			53 pF, Mica, 300 V, 5%
C28	283-0108-00			220 pF, Cer, 200 V, 10%
C30	283-0632-00			87 pF, Mica, 100 V, 1%
C50	283-0167-00			0.1 μF, Cer, 200 V, 10%
C53	283-0004-00			0.02 μF, Cer, 150 V

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C55	290-0527-00			15 pF, Elect., 20 V, 20%
C64	283-0239-00			0.022 µF, Cer, 50 V, 10%
C80	283-0004-00			0.02 µF, Cer, 150 V
C90	283-0641-00			180 pF, Mica, 100 V, 1%
C94	283-0641-00			180 pF, Mica, 100 V, 1%
C101	283-0167-00			0.1 µF, Cer, 200 V, 10%
C130	283-0024-00			0.1 µF, Cer, 30 V, +80%-20%
C150	283-0005-00			0.01 µF, Cer, 250 V, +100%-0%
C180	283-0239-00			0.022 µF, Cer, 50 V, 10%
C185	290-0527-00			15 µF, Elect., 20 V, 20%
C260	290-0527-00			15 µF, Elect., 20 V, 20%
C330	283-0594-00			0.001 µF, Mica, 100 V, 1%
C335	283-0594-00			0.001 µF, Mica, 100 V, 1%
C340	283-0167-00			0.1 µF, Cer, 200 V, 10%
C354	290-0529-00			47 µF, Elect., 20 V, 20%
C512	283-0059-00	B010100	B069999X	1 µF, Cer, 25 V, +80%-20%
C513	283-0000-00	XB070000		0.001 µF, Cer, 500 V, +100%-0%
C514	283-0059-00	B010100	B069999	1 µF, Cer, 25 V, +80%-20%
C514	283-0194-00	B070000		4.7 µF, Elect., 50 V, 20%
C520	290-0367-00			70 µF, Elect., 6 V, 20%
C535	283-0059-00	B010100	B069999X	1 µF, Cer, 25 V, +80%-20%
C537	281-0659-00	XB070000		4.3 pF, Cer, 500 V, ±0.25 pF
C558	283-0648-00			10 pF, Mica, 100 V, ±0.5 pF
C560	281-0092-00	B010100	B069999X	9-35 pF, Var, Cer
C565	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C570	283-0670-00	B010100	B069999X	375 pF, Mica, 500 V, 1%
C577	283-0663-00	B010100	B069999X	16.8 pF, Mica, 500 V, ±0.5 pF
C580	281-0092-00	B010100	B069999	9-35 pF, Var, Cer
C580	283-0003-00	B070000		0.01 µF, Cer, 150 V, +80%-20%
C590	281-0632-00	B010100	B069999X	35 pF, Cer, 500 V, 1%
C593	283-0003-00	XB070000		0.01 µF, Cer, 150 V, +80%-20%
C595	283-0003-00	XB070000		0.01 µF, Cer, 150 V, +80%-20%
C596	283-0003-00	XB070000		0.01 µF, Cer, 150 V, +80%-20%
C597	283-0660-00	XB080000		510 pF, Mica, 500 V, 2%
C605	290-0519-00	XB030000	B069999X	100 µF, Elect., 20 V, 20%
C608	290-0519-00	XB030000	B069999X	100 µF, Elect., 20 V, 20%
C610	283-0194-00	XB070000		4.7 µF, Elect., 50 V, 20%
C614	290-0519-00	XB070000		100 µF, Elect., 20 V, 20%
C620	290-0297-00	B010100	B069999	39 µF, Elect., 10 V, 10%
C620	283-0047-00	B070000		270 pF, Cer, 500 V, 5%
C628	283-0178-00	XB070000		0.1 µF, Cer, 100 V, +80%-20%
C650	283-0059-00	B010100	B069999	39 µF, Elect., 10 V, 10%
C650	283-0178-00	B070000		0.1 µF, Cer, 100 V, +80%-20%
C692	290-0530-00			68 µF, Elect., 6 V, 20%
C693	283-0000-00	XB070000		0.001 µF, Cer, 500 V, +100%-0%

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C694	290-0527-00			15 µF, Elect., 20 V, 20%
C695	281-0523-00			100 pF, Cer, 350 V, 20%
C696	283-0599-00	XB070000		98 pF, Mica, 500 V, 5%
C718	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C749	281-0153-00			1.7-11 pF, Var, Air, 250 V
C779	281-0153-00			1.7-11 pF, Var, Air, 250 V
C790	290-0415-00	B010100	B069999	5.6 µF, Elect., 35 V, 10%
C790	290-0526-00	B070000		6.8 µF, Elect., 35 V, 20%
C794	283-0178-00	B010100	B069999X	0.1 µF, Cer, 100 V, +80%-20%
C804	285-0629-00	B010100	B069999	0.047 µF, PTM, 100 V, 20%
C804	285-0622-00	B070000		0.1 µF, Plastic, 100 V, 20%
C812	283-0059-00	B010100	B069999X	1 µF, Cer, 25 V, +80%-20%
C822	283-0001-00	XB070000		0.005 µF, Cer, 500 V
C825	281-0523-00			100 pF, Cer, 350 V, 20%
C844	283-0000-00	B010100	B069999	0.001 µF, Cer, 350 V, 20%
C844	283-0134-00	B070000		0.47 µF, Cer, 50 V, +80%-20%
C849	281-0153-00			1.7-11 pF, Var, Air 250 V
C865	281-0592-00	B010100	B070000	4.7 pF, (nominal value) Selected
C865	283-0648-00	B070000		10 pF, Mica, 100 V, ±0.5 pF
C879	281-0153-00			1.7-11 pF, Var, Air, 250 V
C891	283-0672-00	B010100	B069999X	200 pF, Mica, 500 V, 1%
C898	290-0415-00	B010100	B069999	5.6 µF, Elect., 35 V, 10%
C898	290-0526-00	B070000		6.8 µF, Elect., 35 V, 20%
C910	281-0523-00			100 pF, Cer, 350 V, 20%
C915	283-0644-00			150 pF, Mica, 500 V, 1%
C918	283-0644-00			150 pF, Mica, 500 V, 1%
C919	283-0178-00			0.1 µF, Cer, 100 V, -80%-20%
C927	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C929	283-0059-00			1 µF, Cer, 25 V, +80%-20%
C959	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C968	283-0672-00			200 pF, Mica, 500 V, 1%
C978	281-0592-00	B010100	B069999	4.7 pF, (nominal value) Selected
C978	281-0541-00	B070000		6.8 pF, Cer, 500 V, 10%
C989	283-0194-00	XB070000		4.7 µF, Elect., 50 V , 20%
C990	281-0523-00			100 pF, Cer, 350 V, 20%
C998	290-0135-00			15 pF, Elect., 20 V, 20%
C1000	283-0167-00			0.1 µF, Cer, 200 V, 10%
C1401	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C1460	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C1501	285-0835-00			0.22 µF, PTM, 100 V, 2%
C1515	281-0580-00			470 pF, Cer, 500 V, 10%
C1601	283-0058-00			0.027 µF, Cer, 100 V, 10%

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C1650	281-0580-00			470 pF, Cer, 500 V, 10%
C1701	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C1720	283-0000-00			0.001 µF, Cer, 500 V, +100%-0%
C1730	283-0004-00			0.02 µF, Cer, 150 V
C1755	283-0641-00			180 pF, Mica, 100 V, 1%
C1760	283-0167-00			0.1 µF, Cer, 200 V, 10%
C1770	283-0593-00			0.01 µF, Mica, 100 V, 1%
C1780	285-0626-00			0.0015 µF, PTM, 100 V, 10%
C1798	283-0594-00			0.001 µF, Mica, 100 V, 1%
C1895	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C1902	283-0622-00			450 pF, Mica, 300 V, 1%
C1930	281-0629-00			33 pF, Cer, 600 V, 5%
C1940	281-0546-00			330 pF, Cer, 500 V, 10%
C1950	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C1995	281-0562-00			39 pF, Cer, 500 V
C1998	283-0593-00			0.01 µF, Mica, 100 V, 1%
C2030	283-0026-00	B010100	B029999	0.2 µF, Cer, 25 V, +80%-20%
C2030	290-0519-00	B030000		100 µF, Elect., 20 V, 20%
C2708	283-0119-00			2200 pF, Cer, 200 V, 5%
C2730	283-0597-00			470 pF, Mica, 300 V, 10%
C2936	283-0032-00			470 pF, Cer, 500 V, 5%
C2958	283-0032-00			470 pF, Cer, 500 V, 5%
C3001	290-0522-00			1 µF, Elect., 50 V, 20%
C3011	290-0522-00			1 µF, Elect., 50 V, 20%
C3021	290-0522-00			1 µF, Elect., 50 V, 20%
C3083	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C3121	290-0512-00			22 pF, Elect., 15 V, 20%
C3201	290-0522-00			1 µF, Elect., 50 V, 20%
C3221	290-0522-00			1 µF, Elect., 50 V, 20%
C3231	290-0512-00			22 µF, Elect., 15 V
C3241	290-0522-00			1 µF, Elect., 50 V, 20%
C3242	290-0522-00			1 µF, Elect., 50 V, 20%
C3251	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C3281	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C3283	290-0522-00			1 µF, Elect., 50 V, 20%
C3331	290-0522-00			1 µF, Elect., 50 V, 20%
C3333	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C3341	290-0522-00			1 µF, Elect., 50 V, 20%
C3361	290-0531-00			100 µF, Elect., 10 V, 20%
C3381	290-0527-00			15 µF, Elect., 20 V, 20%
C3383	290-0531-00			100 µF, Elect., 10 V, 20%
C3421	283-0648-00			10 pF, Mica, 100 V, ±0.5 pF
C3431	290-0522-00			1 µF, Elect., 50 V, 20%

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C3441	283-0645-00			790 µF, Mica, 100 V, 1%
C3443	283-0645-00			790 µF, Mica, 100 V, 1%
C3461	283-0647-00			70 pF, Mica, 100 V, 1%
C3467	283-0637-00			20 pF, Mica, 100 V, ±0.5 pF
C3470	281-0131-00			2.4-24.5 pF, Var, Air, 250 V
C3473	283-0638-00			130 pF, Mica, 100 V, 1%
C3491	283-0024-00			0.1 µF, Cer, 30 V
C3551	283-0004-00			0.02 µF, Cer, 150 V, +80%-20%
C3565	281-0131-00			2.4-24.5 pF, Var, Air, 250 V
C3601	290-0522-00			1 µF, Elect., 50 V, 20%
C3651	283-0004-00			0.02 µF, Cer, 150 V
C3711	283-0024-00			0.1 µF, Cer, 30 V, +80%-20%
C3780	283-0648-00			10 pF, (nominal value) Selected
C3881	290-0517-00			6.8 µF, Elect., 35 V, 20%
C4188	283-0111-00			0.1 µF, Cer, 50 V
C4460	283-0032-00			470 pF, Cer, 500 V, 5%
C4620	283-0111-00			0.1 µF, Cer, 50 V
C5022	283-0110-00			0.005 µF, Cer, 150 V
C5040	283-0111-00			0.1 µF, Cer, 50 V
C5042	283-0080-00			0.022 µF, Cer, 25 V, +80%-20%
C5048	283-0177-00			1 µF, Cer, 25 V, +80%-20%
C5049	283-0080-00			0.022 µF, Cer, 25 V, +80%-20%
C5050	283-0256-00			130 pF, Cer, 100 V, 5%
C5065	290-0114-00			47 µF, Elect., 5 V
C5070	283-0080-00			0.022 µF, Cer, 25 V, +80%-20%
C5085	290-0134-00			22 pF, Elect., 15 V, 20%
C5120	283-0256-00			130 pF, Cer, 100 V, 5%
C5141	283-0080-00			0.022 µF, Cer, 25 V, +80%-20%
C5170	283-0004-00			0.02 µF, Cer, 150 V
C5201	290-0415-00			5.6 µF, Elect., 35 V, 10%
C5210	290-0415-00			5.6 µF, Elect., 35 V, 10%
C5225	283-0111-00			0.1 µF, Cer, 50 V
C5245	283-0192-00			0.47 µF, Cer, 3 V, +80%-20%
C5258	283-0596-00			528 pF, Mica, 300 V, 1%
C5270	283-0003-00			0.01 µF, Cer, 150 V, +80%-20%
C5291	283-0080-00			0.022 µF, Cer, 25 V, +80%-20%
C5330	283-0023-00			0.1 µF, Cer, 10 V
C5335	283-0032-00			470 pF, Cer, 500 V, 5%
C5342	283-0032-00			470 pF, Cer, 500 V, 5%
C5362	283-0004-00			0.02 µF, Cer, 150 V
C5410	283-0023-00			0.1 µF, Cer, 10 V, +80%-20%
C5435	283-0192-00			0.47 µF, Cer, 3 V, +80%-20%
C5450	283-0104-00			2000 pF, Cer, 500 V, 5%
C5468	283-0004-00			0.02 µF, Cer, 150 V

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C5518	283-0032-00			470 pF, Cer, 500 V, 5%
C5540	283-0104-00			2000 pF, Cer, 500 V, 5%
C5568	290-0415-00			5.6 μF, Elect., 35 V, 10%
C5570	283-0017-00			1 μF, Cer, 3 V
C5572	283-0004-00			0.02 μF, Cer, 150 V
C5615	283-0618-00			130 pF, Mica, 300 V, 2%
C5620	283-0618-00			130 pF, Mica, 300 V, 2%
C5622	283-0004-00			0.02 μF, Cer, 150 V
C5648	283-0004-00			0.02 μF, Cer, 150 V
C5660	283-0004-00			0.02 μF, Cer, 150 V
C5665	283-0080-00			0.022 μF, Cer, 25 V, +80%-20%
C5670	283-0080-00			0.022 μF, Cer, 25 V, +80%-20%
C5715	283-0004-00			0.02 μF, Cer, 150 V
C5718	281-0503-00			8 pF, Cer, 500 V, ±0.5 pF
C5720	283-0004-00			0.02 μF, Cer, 150 V
C5750	283-0032-00			470 pF, Cer, 500 V, 5%
C5775	290-0415-00			5.6 μF, Elect., 35 V, 10%
C5788	283-0079-00			0.01 μF, Cer, 250 V, 20%
C5799	283-0079-00			0.01 μF, Cer, 250 V, 20%
C5810	283-0004-00			0.02 μF, Cer, 150 V
C5820	283-0651-00			430 pF, Mica, 500 V, 1%
C5824	283-0119-00			2200 pF, Cer, 200 V, 5%
C5826	283-0032-00			470 pF, Cer, 500 V, 5%
C5834	283-0004-00			0.02 μF, Cer, 150 V
C5840	283-0615-00			33 pF, Mica, 500 V, 5%
C5850	290-0415-00			5.6 μF, Elect., 35 V, 10%
C5862	290-0415-00			5.6 μF, Elect., 35 V, 10%
C6042	281-0504-00			10 pF, Cer, 500 V, 10%
C6047	283-0178-00			0.1 μF, Cer, 100 V, +80%-20%
C6051	290-0523-00			2.2 μF, Elect., 20 V, 20%
C6071	283-0615-00			33 pF, Mica, 500 V, 5%
C6078	283-0644-00			150 pF, Mica, 500 V, 1%
C6362	283-0004-00			0.02 μF, Cer, 150 V
C6372	283-0198-00			0.22 μF, Cer, 50 V, 20%
C6382	283-0635-00			51 pF, Mica, 100 V, 1%
C6486	283-0177-00			1 μF, Cer, 25 V, +80%-20%
C6533	283-0643-00			22 pF, Mica, 300 V, ±0.5 pF
C6562	283-0601-00			22 pF, Mica, 300 V, 10%
C6606	283-0004-00			0.02 μF, Cer, 150 V
C6608	283-0000-00			0.001 μF, Cer, 500 V, +100%-0%
C6610	283-0000-00			0.001 μF, Cer, 500 V, +100%-0%
C6614	290-0530-00			68 μF, Elect., 6 V, 20%

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C6663	283-0178-00			0.1 μF, Cer, 100 V, +80%-20%
C6665	283-0177-00			0.1 μF, Cer, 25 V, +80%-20%
C6682	283-0003-00			0.01 μF, Cer, 150 V
C6693	281-0153-00			1.7-11 pF, Var, Air, 250 V
C6712	290-0530-00			68 μF, Elect., 6 V, 20%
C6736	283-0024-00			0.1 μF, Cer, 30 V, +80%-20%
C6748	283-0003-00			0.01 μF, Cer, 150 V
C6763	283-0024-00			0.1 μF, Cer, 30 V, +80%-20%
C6788	281-0153-00			1.7-11 pF, Var, Air, 250 V
C6844	281-0611-00			2.7 pF, Cer, 200 V, ±0.25 pF
C6866	283-0000-00			0.001 μF, Cer, 500 V, +100%-0%
C6887	283-0000-00			0.001 μF, Cer, 500 V, +100%-0%
C6979	283-0000-00			0.001 μF, Cer, 500 V, +100%-0%
C7001	283-0602-00			53 pF, Mica, 300 V, 5%
C7021	283-0111-00			0.1 μF, Cer, 50 V
C7061	283-0003-00			0.01 μF, Cer, 150 V, +80%-20%
C7121	283-0059-00			1 μF, Cer, 25 V, +80%-20%
C7211	281-0627-00			1 pF, Cer, 600 V
C7221	283-0004-00			0.02 μF, Cer, 150 V
C7301	283-0640-00			160 pF, Mica, 100 V, 1%
C7303	283-0630-00			110 pF, Mica, 100 V, 1%
C7305	283-0649-00			105 pF, Mica, 300 V, 1%
C7307	283-0596-00			528 pF, Mica, 300 V, 1%
C7309	283-0636-00			36 pF, Mica, 100 V, ±0.5 pF
C7310	283-0633-00			77 pF, Mica, 100 V, 1%
C7311	283-0649-00			105 pF, Mica, 300 V, 1%
C7312	283-0644-00			150 pF, Mica, 500 V, 1%
C7381	283-0640-00			160 pF, Mica, 100 V, 1%
C7383	283-0177-00			1 μF, Cer, 25 V, +80%-20%
C7401	283-0639-00			56 pF, Mica, 100 V, 1%
C7403	283-0603-00			113 pF, Mica, 300 V, 2%
C7431	283-0004-00			0.02 μF, Cer, 150 V
C7451	283-0111-00	B010100	B059999X	0.1 μF, Cer, 50 V
C7461	281-0166-00			1.9-15.7 pF, Var, Air, 250 V
C7463	281-0166-00			1.9-15.7 pF, Var, Air, 250 V
C7481	283-0177-00			1 μF, Cer, 25 V, +80%-20%
C7491	283-0065-00			0.001 μF, Cer 100 V, 5%
C7501	283-0636-00			36 pF, Mica, 100 V, ±0.5 pF
C7503	283-0674-00			85 pF, Mica, 500 V, 1%
C7505	283-0643-00			22 pF, Mica, 300 V, ±0.5 pF
C7507	283-0600-00			43 pF, Mica, 500 V, 5%
C7508	283-0639-00			56 pF, Mica, 100 V, 1%

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C7509	283-0638-00			130 pF, Mica, 100 V, 1%
C7533	283-0635-00			51 pF, Mica, 100 V, 1%
C7551	283-0065-00			0.001 μF, Cer, 100 V, 5%
C7555	283-0598-00			253 pF, Mica, 300 V, 5%
C7601	283-0643-00			22 pF, Mica, 300 V, ±0.5 pF
C7603	283-0635-00			51 pF, Mica, 100 V, 1%
C7671	283-0065-00			0.001 μF, Cer, 100 V, 5%
C7681	290-0367-00			70 μF, Elect., 6 V, 20%
C7711	290-0524-00			4.7 μF, Elect., 10 V, 20%
C7731	283-0644-00			150 pF, Mica, 500 V, 1%
C7781	283-0111-00			0.1 μF, Cer, 50 V
C7783	290-0531-00			100 μF, Elect., 10 V, 20%
C7791	281-0661-00			0.8 pF, Cer, 500 V, ±0.1 pF
C7801	281-0626-00			3.3 pF, Cer, 500 V, 5%
C7803	283-0598-00			252 pF, Mica, 300 V, 5%
C7861	283-0003-00			0.01 μF, Cer, 150 V, +80%-20%
C7883	283-0111-00			0.1 μF, Cer, 50 V
C7891	283-0633-00			77 pF, Mica, 100 V, 1%
C7901	283-0003-00			0.01 μF, Cer, 150 V, +80%-20%
C7903	290-0517-00			6.8 μF, Elect., 35 V, 20%
C7951	283-0177-00			1 μF, Cer, 25 V, +80%-20%
C8015	283-0647-00			70 pF, Mica, 100 V, 1%
C8037	283-0647-00			70 pF, Mica, 100 V, 1%
C8039	283-0004-00			0.02 μF, Cer, 150 V
C8050	283-0004-00			0.02 μF, Cer, 150 V
C8075	283-0004-00	B010100	B059999X	0.02 μF, Cer, 150 V
C8090	283-0004-00			0.02 μF, Cer, 150 V
C8110	283-0003-00	B010100	B019999	0.01 μF, Cer, 150 V, +80%-20%
C8110	283-0238-00	B020000		0.01 μF, Cer, 50 V, 10%
C8120	283-0000-00			0.001 μF, Cer, 500 V, +100%-0%
C8135	283-0000-00			0.001 μF, Cer, 500 V, +100%-0%
C8180	283-0003-00			0.01 μF, Cer, 150 V, +80%-20%
C8185	283-0003-00			0.01 μF, Cer, 150 V, +80%-20%
C8189	283-0004-00			0.02 μF, Cer, 150 V
C8190	283-0605-00	B010100	B049999	678 pF, Mica, 300 V, 1%
C8190	283-0687-00	B050000		560 pF, Mica, 300 V, 2%
C8240	283-0084-00			270 pF, Cer, 1000 V, 5%
C8250	283-0004-00			0.02 μF, Cer, 150 V
C8264	283-0203-00			0.47 μF, Cer, 50 V, 20%
C8282	283-0004-00			0.02 μF, Cer, 150 V
C8290	283-0084-00			270 pF, Cer, 1000 V, 5%
C8295	283-0113-00			56 pF, Cer, 500 V, 1%

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C8330	283-0000-00	B010100	B019999	0.001 μF, Cer, 500 V, +100%-0%
C8330	283-0065-00	B020000		0.001 μF, Cer, 100 V, 5%
C8350	283-0004-00			0.02 μF, Cer, 150 V
C8375	283-0004-00			0.02 μF, Cer, 150 V
C8410	283-0004-00			0.02 μF, Cer, 150 V
C8460	283-0600-00			43 pF, Mica, 500 V, 5%
C8470	283-0084-00			270 pF, Cer, 1000 V, 5%
C8490	283-0649-00			105 pF, Mica, 300 V, 1%
C8530	283-0596-00			528 pF, Mica, 300 V, 1%
C8535	283-0598-00			253 pF, Mica, 300 V, 5%
C8555	283-0084-00			270 pF, Cer, 1000 V, 5%
C8558	283-0084-00			270 pF, Cer, 1000 V, 5%
C8572	283-0084-00			270 pF, Cer, 1000 V, 5%
C8580	283-0638-00			130 pF, Mica, 100 V, 1%
C8590	283-0601-00			22 pF, Mica, 300 V, 10%
C8610	283-0026-00			0.2 μF, Cer, 25 V, +80%-20%
C8635	283-0647-00			70 pF, Mica, 100 V, 1%
C8650	283-0084-00			270 pF, Cer, 1000 V, 5%
C8668	283-0004-00			0.02 μF, Cer, 150 V
C8687	283-0004-00			0.02 μF, Cer, 150 V
C8689	281-0064-00			0.25-1.5 pF, Var, Plastic
C8742	283-0636-00			36 pF, Mica, 100 V, ±0.5 pF
C8845	283-0000-00	B010100	B069999	0.001 μF, Cer, 500 V, +100%-0%
C8845	283-0176-00	B070000		0.0022 μF, Cer, 50 V, 20%
C8959	290-0522-00			1 μF, Elect., 50 V, 20%
C8965	283-0024-00			0.1 μF, Cer, 30 V, +80%-20%
C8996	283-0648-00			10 pF, Mica, 100 V, ±0.5 pF
C9011	290-0334-00			1250 μF, Elect., 50 V, +75%-10%
C9042	290-0321-00			11,000 μF, Elect., 15 V, +100%-0%
C9061	290-0086-00			2000 μF, Elect., 30 V
C9082	283-0003-00	XB070000		0.01 μF, Cer, 150 V, +80%-20%
C9084	283-0003-00	XB070000		0.01 μF, Cer, 150 V, +80%-20%
C9086	283-0003-00	XB070000		0.01 μF, Cer, 150 V, +80%-20%
C9088	281-0625-00	XB070000		35 pF, Cer, 500 V, 5%
C9215	283-0111-00			0.1 μF, Cer, 50 V
C9218	283-0003-00	XB070000		0.01 μF, 150 V, +80%-20%
C9802	285-0598-00			0.01 μF, PTM, 100 V, 5%

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
CAPACITORS (cont)				
C9810	283-0026-00			0.2 µF, Cer, 25 V, +80%-20%
C9812	290-0296-00			100 µF, Elect., 20 V, 20%
C9830	285-0598-00			0.01 µF, µTM, 100 V, 5%
C9832	283-0026-00			0.2 µF, Cer, 25 V
C9840	290-0135-00			15 µF, Elect., 20 V, 20%
C9850	290-0135-00			15 µF, Elect., 20 V, 20%
C9852	283-0026-00			0.2 µF, Cer, 25 V, +80%-20%
C9854	281-0549-00			68 pF, Cer, 500 V, 10%
C9856	285-0598-00			0.01 µF, PTM, 100 V, 5%
DIODES				
CR7	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR35	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR250	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR329	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR338	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR584	152-0141-02	XB070000		Silicon, replaceable by 1N4152
CR585	152-0141-02	XB070000		Silicon, replaceable by 1N4152
CR588	152-0141-02	XB070000		Silicon, replaceable by 1N4152
CR610	152-0185-00	B010100	B069999X	Silicon, selected from 1N4152 or 1N3605
CR651	152-0141-02	XB070000		Silicon, replaceable by 1N4152
CR660	152-0185-00	B010100	B069999X	Silicon, selected from 1N4152 or 1N3605
CR664	152-0141-02	XB070000		Silicon, replaceable by 1N4152
CR720	152-0269-00			Silicon, replaceable by 1N3182, Var capacity 33 pF
CR740	152-0185-00	B010100	B069999	Silicon, selected from 1N4152 or 1N3605
CR740	152-0141-02	B070000		Silicon, replaceable by 1N4152
CR792	152-0269-00	B010100	B069999X	Silicon, selected from 1N4152 or 1N3605
CR796	152-0185-00	B010100	B069999	Silicon, selected from 1N4152 or 1N3605
CR796	152-0141-02	B070000		Silicon, replaceable by 1N4152
CR894	152-0185-00	B010100	B069999X	Silicon, selected from 1N4152 or 1N3605
CR895	152-0185-00	B010100	B069999X	Silicon, selected from 1N4152 or 1N3605
CR896	152-0185-00	B010100	B069999X	Silicon, selected from 1N4152 or 1N3605
CR924	152-0185-00	B010100	B069999	Silicon, selected from 1N4152 or 1N3605
CR924	152-0141-02	B070000		Silicon, replaceable by 1N4152
CR944	152-0185-00	B010100	B069999	Silicon, selected from 1N4152 or 1N3605
CR944	152-0141-02	B070000		Silicon, replaceable by 1N4152
CR992	152-0185-00	B010100	B069999	Silicon, selected from 1N4152 or 1N3605
CR992	152-0141-02	B070000		Silicon, replaceable by 1N4152
CR1301	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR1420	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR1510	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR1544	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR1720	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR1740	152-0269-00			Silicon, replaceable by 1N3182, Var capacity 33 pF
CR1795	152-0185-00			Silicon, selected from 1N4152 or 1N3605

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
SCD, DIODES (cont)				
CR1830	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR1930	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3351	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3411	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3413	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3451	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3531	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3533	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3551	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3641	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3651	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3653	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3711	152-0153-00			Silicon, replaceable by FD7003 or CD5574
CR3721	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3723	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3725	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3811	152-0153-00			Silicon, replaceable by FD7003 or CD5574
CR3821	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3823	152-0185-00			Silcion, selected from 1N4152 or 1N3605
CR3881	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3911	152-0153-00			Silicon, replaceable by FD7003 or CD5574
CR3913	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3921	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR3923	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR4570	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR4784	152-0185-00			Silicon, selected from 1N4152 o 1N3605
CR5010	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5015	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5030	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5035	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5255	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5260	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5265	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5270	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5331	152-0322-00			Silicon, replaceable by A1108
CR5335	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5340	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5365	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5370	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5380	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5411	152-0322-00			Silicon, replaceable by A1108
CR5415	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5420	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5570	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5571	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5572	152-0185-00			Silicon, selected from 1N4152 or 1N3605

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
SCD, DIODES (cont)				
CR5674	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5676	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5835	152-0269-00			Silicon, replaceable by 1N3182, Var capacity, 33 pF
CR5855	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5865	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5877	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5878	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5885	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5887	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR5940	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6013	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6017	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6019	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6022	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6028	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6033	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6037	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6048	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6112	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6114	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6118	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6122	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6128	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6132	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6136	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6182	152-0125-00			Tunnel, TD3A, 4.7 mA
CR6306	152-0141-02			Silicon, replaceable by 1N4152
CR6308	152-0141-02			Silicon, replaceable by 1N4152
CR6316	152-0141-02			Silicon, replaceable by 1N4152
CR6318	152-0141-02			Silicon, replaceable by 1N4152
CR6322[1]	152-0442-00			Schottky barrier
CR6328[2]	152-0442-00			Schottky barrier
CR6331	152-0141-02			Silicon, replaceable by 1N4152
CR6335	152-0141-02			Silicon, replaceable by 1N4152
CR6338	152-0141-02			Silicon, replaceable by 1N4152
CR6344	152-0141-02			Silicon, replaceable by 1N4152
CR6348[3]	152-0442-00			Schottky barrier
CR6376	152-0322-00			Silicon, replaceable by A1108
CR6404[4]	152-0442-00			Schottky barrier
CR6464	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6466	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6469	152-0457-00			Silicon, replaceable by MD0288
CR6588	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6603	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6634	153-0029-00			Silicon, selected from 1N4152 or 1N3605 (matched pair)
CR6703	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6705	152-0153-00			Silicon, replaceable by FD7003 or CD5574
CR6709	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6789	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6885	152-0185-00			Silicon, selected from 1N4152 or 1N3605

[1] Matched pair with CR6348.
[2] Matched pair with CR6404.
[3] Matched pair with CR6322.
[4] Matched pair with CR6328.

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
SCD, DIODES (cont)				
CR6913	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6915	152-0185-00			Silicon, selected from 1N4152 or 1N3604
CR6918	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6920	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6923	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6925	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6966	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6987	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR6988	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR7001	152-0153-00			Silicon, replaceable by FD7003 or CD5574
CR7041	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR7091	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR7093	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR7095	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR7210	152-0075-00			Germanium, replaceable by GD238 or ED48
CR7341	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR7343	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR7345	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR7347	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR7581	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR7711	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR7951	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8095	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8098	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8166	152-0269-00			Silicon, replaceable by 1N3182, Var capacity, 33 pF
CR8168	152-0269-00			Silicon, replaceable by 1N3182, Var capacity, 33 pF
CR8188	152-0269-00			Silicon, replaceable by 1N3182, Var capacity, 33 pF
CR8220	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8350	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8352	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8375	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8378	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8620	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8710	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8810	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8812	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8816	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8818	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8842	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8912	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR8914	152-0185-00			Silicon, selected from 1N4152 or 1N3605
CR9802	152-0198-00			Silicon, replaceable by 1N4721
CR9804	152-0198-00			Silicon, replaceable by 1N4721
CR9830	152-0066-00			Silicon, selected from 1N3194
CR9832	152-0066-00			Silicon, selected from 1N3194
CR9834	152-0066-00			Silicon, selected from 1N3194
CR9836	152-0066-00			Silicon, selected from 1N3194
CR9870	152-0066-00			Silicon, selected from 1N3194
CR9872	152-0066-00			Silicon, selected from 1N3194
CR9874	152-0066-00			Silicon, selected from 1N3194
CR9878	152-0066-00			Silicon, selected from 1N3194
VR6484	152-0226-00			Zener, replaceable by 1N751A, 0.4 W, 5.1 V, 5%
VR7161	152-0278-00			Zener, replaceable by 1N4372A, 0.4 W, 3 V, 5%
VR9850	152-0212-00			Zener, replaceable by 1N936, 0.5 W, 9 V, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
BULBS				
DS9201	150-0018-00			Incandescent, miniature, 6.3 V, #12
DS9202	150-0048-00			Incandescent, #683
DS9210	150-0048-00			Incandescent, #683
DS9211	150-0048-00			Incandescent, #683
DS9220	150-0048-00			Incandescent, #683
DS9221	150-0048-00			Incandescent, #683
DS9222	150-0048-00			Incandescent, #683
FUSES				
F9201	159-0042-00			0.75 A, 3 AG, fast-blo
F9202	159-0025-00			0.5 A, 3 AG, fast-blo
LINE FILTER				
FL9201	119-0095-06			Filter, RI 2 x 1 A, 250 V AC, 400 Hz
CONNECTORS				
J9014	131-0324-00			24 pin, female
J9210	131-0106-02			Receptacle, electrical, BNC
J9240	131-0106-02			Receptacle, electrical, BNC
J9250	131-0106-02			Receptacle, electrical, BNC
RELAYS				
K390	148-0064-00			Resonant reed, SPST
K580	148-0071-00	B010100	B069999X	Armature, DPDT
K9080	148-0034-00	XB070000		Armature, DPDT
INDUCTORS				
L20	114-0222-00			2-6 μH, Var, Core 276-0568-00
L30	114-0222-00			2-6 μH, Var, Core 276-0568-00
L94	114-0280-00			12-43 μH, Var, Core 276-0568-00
L520	276-0507-00	XB060000		Core, ferramic suppressor
L570	108-0673-00	B010100	B069999X	2.2 μH
L618	108-0249-00	B010100	B069999X	12 μH
L720	108-0226-00			100 μH
L792	108-0249-00	B010100	B069999X	12 μH
L912	108-0443-00	XB070000		25 μH
L1670	114-0308-00			2.9-6.5 μH, Var, Core 276-0506-00
L1770	108-0443-00			25 μH
L1850	108-0174-00			245 μH
L3070	108-0395-00			64 μH
L5055	108-0317-00			15 μH
L5101	114-0303-00			6.5-2.3 μH, Var, Core 276-0506-00
L5242	108-0174-00			245 μH
L5320	108-0174-00			245 μH
L5601	108-0317-00			15 μH
L5830	108-0231-00			4.5 μH
L6852[1]	276-0507-00	XB080000		Core, ferramic suppressor
L7110	114-0220-00			1-3 μH, Var, Core 276-0568-00
L7301	114-0280-00			12-43 μH, Var, Core 276-0568-00
L7311	114-0222-00			2-6 μH, Var, Core 276-0568-00
L7391	108-0249-00			12 μH

[1]Added if necessary.

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
INDUCTORS (cont)				
L7401	114-0278-00			4.6-16.7 µH, Var, Core 276-0568-00
L7403	114-0220-00			1-3 µH, Var, Core 276-0568-00
L7411	114-0220-00			1-3 µH, Var, Core 276-0568-00
L7501	114-0278-00			4.6-16.7 µH, Var, Core 276-0568-00
L7511	114-0220-00			1-3 µH, Var, Core 276-0568-00
L7601	114-0280-00			12-43 µH, Var, Core 276-0568-00
L7611	114-0220-00			1-3 µH, Var, Core 276-0568-00
L7631	108-0443-00			25 µH
L8010	108-0443-00			25 µH
L8030	108-0443-00			25 µH
L8050	114-0254-00			30-60 µH, Var, Core 276-0506-00
L8150	114-0254-00	B010100	B059999	30-60 µH, Var, Core 276-0506-00
L8150	114-0310-00	B060000		22-80 µH, Var, Core 276-0568-00
L8190	114-0177-00			280-650 µH, Var, Core not replaceable
L8390	114-0177-00			280-650 µH, Var, Core not replaceable
L8580	114-0281-00			35-70 µH, Var, Core 276-0540-00
L8590	114-0281-00			35-70 µH, Var, Core 276-0540-00
L8640	114-0219-00			45-130 µH, Var, Core 276-0568-00
L8660	120-0587-00			Toriod, four 10 turn windings
L8680	120-0524-00			Toroid, 12 turns, quadfilar
TRANSISTORS				
Q10	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q30	151-0221-00			Silicon, PNP, replaceable by 2N4258
Q40	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q50	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q55	151-0164-00			Silicon, PNP, replaceable by 2N5447 or 2N3702
Q60	151-0225-00			Silicon, NPN, selected from 2N3563 or replaceable by CS23366
Q70	151-0225-00			Silicon, NPN, selected from 2N3563 or replaceable by CS23366
Q80	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q90	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q160	151-0103-00			Silicon, NPN, replaceable by 2N2219
Q230	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q240	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q250	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q260	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q319	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q350	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q355	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q380	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q510	151-0190-00	B010100	B069999	Silicon, NPN, replaceable by 2N3904 or TE3904
Q510	151-0190-01	B070000		Silicon, NPN, replaceable by 2N3904 or TE3904
Q520	151-0190-00	B010100	B069999	Silicon, NPN, replaceable by 2N3904 or TE3904
Q520	151-0190-01	B070000		Silicon, NPN, replaceable by 2N3904 or TE3904

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TRANSISTORS (cont)				
Q540	151-0190-00	B010100	B069999	Silicon, NPN, replaceable by 2N3904 or TE3904
Q540	151-0190-01	B070000		Silicon, NPN, replaceable by 2N3904 or TE3904
Q550	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q560	151-0301-00	XB070000		Silicon, PNP, replaceable by 2N3907
Q565	151-0190-01	XB070000		Silicon, NPN, replaceable by 2N3904 or TE3904
Q570	151-0301-00	XB070000		Silicon, PNP, replaceable by 2N3907
Q580	151-0190-00	B010100	B069999	Silicon, NPN, replaceable by 2N3904 or TE3904
Q580	151-0190-01	B070000		Silicon, NPN, replaceable by 2N3904 or TE3904
Q620	151-0220-00	B010100	B019999	Silicon, PNP, replaceable by 2N4122
Q620	151-0216-00	B020000	B069999	Silicon, PNP, replaceable by MPS6523
Q620	151-0190-01	B070000		Silicon, NPN, replaceable by 2N3904 or TE3904
Q630	151-0190-00	B010100	B069999	Silicon, NPN, replaceable by 2N3904 or TE3904
Q630	151-0216-00	B070000		Silicon, PNP, replaceable by MPS6523
Q640	151-0190-00	B010100	B069999	Silicon, NPN, replaceable by 2N3904 or TE3904
Q640	151-0190-01	B070000		Silicon, NPN, replaceable by 2N3904 or TE3904
Q658	151-0301-00	XB070000		Silicon, PNP, replaceable by 2N3907
Q680	151-0190-00	B010100	B069999	Silicon, NPN, replaceable by 2N3904 or TE3904
Q680	151-0190-01	B070000		Silicon, NPN, replaceable by 2N3904 or TE3904
Q730A,B	151-0104-00			Silicon, NPN, selected from 2N2919, dual
Q740	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q750	151-0220-00	B010100	B019999	Silicon, PNP, replaceable by 2N4122
Q750	151-0216-00	B020000		Silicon, PNP, replaceable by MPS6523
Q760	151-0220-00	B010100	B019999	Silicon, PNP, replaceable by 2N4122
Q760	151-0216-00	B020000		Silicon, PNP, replaceable by MPS6523
Q790	151-0301-00			Silicon, PNP, replaceable by 2N3907
Q810	151-0220-00	B010100	B069999X	Silicon, PNP, replaceable by 2N4122
Q820	151-0199-00	B010100	B069999	Silicon, PNP, replaceable by MPS3640
Q820	151-1039-00	B070000		Silicon, FET, replaceable by 2N5462
Q840	151-0190-00	B010100	B069999	Silicon, NPN, replaceable by 2N3904 or TE3904
Q840	151-0190-01	B070000		Silicon, NPN, replaceable by 2N3904 or TE3904
Q860	151-0190-00	B010100	B069999	Silicon, NPN, replaceable by 2N3904 or TE3904
Q860	151-0190-01	B070000		Silicon, NPN, replaceable by 2N3904 or TE3904
Q880	151-0190-00	B010100	B069999	Silicon, NPN, replaceable by 2N3904 or TE3904
Q880	151-0190-01	B070000		Silicon, NPN, replaceable by 2N3904 or TE3904
Q885	151-0190-00	B010100	B069999	Silicon, NPN, replaceable by 2N3904 or TE3904
Q885	151-0190-01	B070000		Silicon, NPN, replaceable by 2N3904 or TE3904
Q900	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q905	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q920	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q930	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q950	151-0220-00	B010100	B019999	Silicon, PNP, replaceable by 2N4122
Q950	151-0216-00	B020000		Silicon, PNP, replaceable by MPS6523
Q960	151-0220-00	B010100	B019999	Silicon, PNP, replaceable by 2N4122
Q960	151-0216-00	B020000		Silicon, PNP, replaceable by MPS6523
Q965	151-0190-00	B010100	B069999	Silicon, NPN, replaceable by 2N3904 or TE3904
Q965	151-0190-01	B070000		Silicon, NPN, replaceable by 2N3904 or TE3904

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TRANSISTORS (cont)				
Q980	151-0301-00			Silicon, PNP, replaceable by 2N2907
Q990	151-0190-00	B010100	B069999	Silicon, NPN, replaceable by 2N3904 or TE3904
Q990	151-0190-01	B070000		Silicon, NPN, replaceable by 2N3904 or TE3904
Q1401	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1411	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1421	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q1501	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1601	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1631	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1691	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q1701	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1721	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q1731	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1741	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1791	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q1801	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1811	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1901	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q1911	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1921	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q1991	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q2710	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q3040	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q3050	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q3060	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q3070	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q3110	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q3130	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q3210	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q3240	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q3250	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q3300	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q3360	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q3370	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q3420	151-0192-00			Silicon, NPN, selected from MPS6521
Q3430	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q3440	151-1039-00			Silicon, FET, replaceable by 2N5462
Q3450	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q3470	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q3510	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q3520	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q3530	151-0301-00			Silicon, PNP, replaceable by 2N2907
Q3540	151-0269-00			Silicon, NPN, replaceable by SE3005
Q3545	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q3580	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q3600	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q3610	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q3645	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q3720	151-0192-00			Silicon, NPN, selected from MPS6521
Q3780	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q3820	151-0192-00			Silicon, NPN, selected from MPS6521
Q3825	151-0192-00			Silicon, NPN, selected from MPS6521

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TRANSISTORS (cont)				
Q3880	151-0192-00			Silicon, NPN, selected from MPS6521
Q3890	151-0192-00			Silicon, NPN, selected from MPS6521
Q3920	151-0192-00			Silicon, NPN, selected from MPS6521
Q4180	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q4190	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q4280	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q4290	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q4380	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q4390	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q4480	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q4490	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5021	151-0221-00			Silicon, PNP, replaceable by 2N4258
Q5031	151-0221-00			Silicon, PNP, replaceable by 2N4258
Q5041	151-0221-00			Silicon, PNP, replaceable by 2N4258
Q5051	151-0221-00			Silicon, PNP, replaceable by 2N4258
Q5091	151-0224-00			Silicon, NPN, replaceable by 2N3692
Q5131	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5141	151-0164-00			Silicon, PNP, replaceable by 2N5447 or 2N3702
Q5151	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q5161	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5171	151-0192-00			Silicon, NPN, selected from MPS6521
Q5181	151-0192-00			Silicon, NPN, selected from MPS6521
Q5191	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q5231	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5241	151-0198-00			Silicon, NPN, replaceable by MPS918
Q5251	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q5261	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5271	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5281	151-0192-00			Silicon, NPN, selected from MPS6521
Q5291	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q5311	151-0198-00			Silicon, NPN, replaceable by MPS918
Q5331	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q5341	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5351	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5361	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q5371	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5381	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5391	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5431	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q5441	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5451	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5461	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5471	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q5481	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5491	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q5511	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q5521	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q5551	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q5561	151-0224-00			Silicon, NPN, replaceable by 2N3692
Q5571	151-0224-00			Silicon, NPN, replaceable by 2N3692
Q5581	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q5591	151-0127-00			Silicon, NPN, selected from 2N2369
Q5561	151-0188-00			Silicon, PNP, replaceable by 2N3906

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TRANSISTORS (cont)				
Q5681	151-0127-00			Silicon, NPN, selected from 2N2369
Q5721	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q5731	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5741	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5751	151-0192-00			Silicon, NPN, selected from MPS6521
Q5761	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q5771	151-0192-00			Silicon, NPN, selected from MPS6521
Q5781	151-0192-00			Silicon, NPN, selected from MPS6521
Q5791	151-0192-00			Silicon, NPN, selected from MPS6521
Q5821	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q5831	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q5841	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q5851	151-0192-00			Silicon, NPN, selected from MPS6521
Q5861	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q5871	151-0192-00			Silicon, NPN, selected from MPS6521
Q5881	151-0192-00			Silicon, NPN, selected from MPS6521
Q5891	151-0192-00			Silicon, NPN, selected from MPS6521
Q5931	151-0207-00			Silicon, NPN, replaceable by 2N3415
Q5941	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q5951	151-0164-00			Silicon, PNP, replaceable by 2N5447 or 2N3702
Q5961	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q5971	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q5981	151-0192-00			Silicon, NPN, selected from MPS6521
Q5991	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q6068	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q6091	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q6095	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q6103	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q6106	151-0192-00			Silicon, NPN, selected from MPS6521
Q6110	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q6149	151-0192-00			Silicon, NPN, selected from MPS6521
Q6162	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q6164	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q6192	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q6198	151-0221-00			Silicon, PNP, replaceable by 2N4258
Q6212	151-0192-00			Silicon, NPN, selected from MPS6521
Q6222	151-0192-00			Silicon, NPN, selected from MPS6521
Q6228	151-0192-00			Silicon, NPN, selected from MPS6521
Q6233	151-0192-00			Silicon, NPN, selected from MPS6521
Q6244	151-0192-00			Silicon, NPN, selected from MPS6521
Q6255	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q6262	151-0192-00	B010100	B069999	Silicon, NPN, selected from MPS6521
Q6262	151-0341-00	B070000		Silicon, NPN, replaceable by 2N3565
Q6266	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q6298	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q6392	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q6398	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q6452	151-0192-00			Silicon, NPN, selected from MPS6521
Q6478	151-0133-00			Silicon, PNP, replaceable by MM999 or selected from 2N3251
Q6482	151-0271-00			Silicon, PNP, replaceable by SAB4113

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TRANSISTORS (cont)				
Q6494	151-0103-00			Silicon, NPN, replaceable by 2N2219
Q6496	151-0103-00			Silicon, NPN, replaceable by 2N2219
Q6569	151-0192-00			Silicon, NPN, selected from MPS6521
Q6593	151-0103-00			Silicon, NPN, replaceable by 2N2219
Q6624A,B	151-0287-00	B010100	B059999	Silicon, PNP, replaceable by 2N4854, dual
Q6624A,B	151-0361-00	B060000		Silicon, NPN, & PNP, replaceable by TD702, dual
Q6653A,B	151-0236-00			Silicon, NPN, replaceable by SA2700 or ITS1074
Q6672	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q6715	151-0192-00			Silicon, NPN, selected from MPS6521
Q6758	151-0271-00			Silicon, PNP, replaceable by SAB4113
Q6772	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q6786	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q6803	151-0192-00			Silicon, NPN, selected from MPS6521
Q6813	151-0192-00			Silicon, NPN, selected from MPS6521
Q6824	151-0192-00			Silicon, NPN, selected from MPS6521
Q6828	151-0192-00			Silicon, NPN, selected from MPS6521
Q6852	151-0103-00			Silicon, NPN, replaceable by 2N2219
Q6858	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q6877	151-0271-00			Silicon, PNP, replaceable by SAB4113
Q7001	151-0333-00			Silicon, NPN, selected from MPS918
Q7191	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q7221A,B	151-0139-00			Silicon, NPN, selected from D/2N918, dual
Q7241	151-0192-00			Silicon, NPN, selected from MPS6521
Q7251	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q7321	151-0192-00			Silicon, NPN, selected from MPS6521
Q7331	151-0192-00			Silicon, NPN, selected from MPS6521
Q7431	151-0219-00			Silicon, PNP, replaceable by 2N4250
Q7441	151-0192-00			Silicon, NPN, selected from MPS6521
Q7443	151-0192-00			Silicon, NPN, selected from MPS6521
Q7481	151-0269-00			Silicon, NPN, replaceable by SE3005
Q7531	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q7551	151-0269-00			Silicon, NPN, replaceable by SE3005
Q7571	151-0269-00			Silicon, NPN, replaceable by SE3005
Q7711	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q7761A, B	151-0236-00			Silicon, NPN, replaceable by SA2700 or ITS1074, dual
Q7763A, B	151-0236-00			Silicon, NPN, replaceable by SA2700 or ITS1074, dual
Q7771	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q7781	151-0271-00			Silicon, PNP, replaceable by SAB4113
Q7783	151-0103-00			Silicon, NPN, replaceable by 2N2219
Q7811	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q7911	151-0220-00			Silicon, PNP, replaceable by 2N4122
Q7921	151-0103-00			Silicon, NPN, replaceable by 2N2219
Q7961	151-0164-00			Silicon, PNP, replaceable by 2N5447 or 2N3702
Q7971	151-0192-00			Silicon, NPN, selected from MPS6521
Q7981	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q8020	151-0192-00			Silicon, NPN, selected from MPS6521
Q8090	151-0192-00			Silicon, NPN, selected from MPS6521
Q8110	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q8120	151-0192-00			Silicon, NPN, selected from MPS6521
Q8130	152-0192-00			Silicon, NPN, selected from MPS6521
Q8140	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q8145	151-0192-00			Silicon, NPN, selected from MPS6521

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TRANSISTORS (cont)				
Q8160	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q8170	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q8350	151-0192-00			Silicon, NPN, selected from MPS6521
Q8355	151-0269-00			Silicon, NPN, replaceable by SE3005
Q8360	151-0269-00			Silicon, NPN, replaceable by SE3005
Q8370	151-0192-00			Silicon, NPN, selected from MPS6521
Q8430	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q8455	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q8460	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q8530	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q8540	151-0223-00			Silicon, NPN, replaceable by 2N4275
Q8560	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q8570	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q8620	151-0192-00			Silicon, NPN, selected from MPS6521
Q8630	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q8670	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q8720	151-0192-00			Silicon, NPN, selected from MPS6521
Q8820	151-0192-00			Silicon, NPN, selected from MPS6521
Q8825	151-0192-00			Silicon, NPN, selected from MPS6521
Q8850	151-0236-00			Silicon, NPN, replaceable by SA2700 or ITS1074
Q8860	151-0232-00			Silicon, NPN, replaceable by NS7384 or selected from 2N2919
Q8920	151-0192-00			Silicon, NPN, selected from MPS6521
Q8950	151-0216-00			Silicon, PNP, replaceable by MPS6523
Q8955	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q9035	151-0140-00			Silicon, NPN, selected from 2N3055
Q9055	151-0140-00			Silicon, NPN, selected from 2N3055
Q9085	151-0148-00	B010100	B059999	Silicon, NPN, selected from 40250
Q9085	151-0140-00	B060000		Silicon, NPN, selected from 2N3055
Q9800	151-0301-00			Silicon, PNP, replaceable by 2N2907
Q9802	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q9804	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q9806	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q9830	151-0301-00			Silicon, PNP, replaceable by 2N2907
Q9832	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q9834	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q9836	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q9850	151-0301-00			Silicon, PNP, replaceable by 2N2907
Q9852	151-0188-00			Silicon, PNP, replaceable by 2N3906
Q9854	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
Q9856	151-0190-00			Silicon, NPN, replaceable by 2N3904 or TE3904
RESISTORS				
R3	321-0193-00			1 kΩ, 1/8 W, 1%
R5	321-0251-00			4.02 kΩ, 1/8 W, 1%
R7	321-0239-00			3.01 kΩ, 1/8 W, 1%
R12	315-0220-00			22 Ω, 1/4 W, 5%
R30	321-0277-00			7.5 kΩ, 1/8 W, 1%
R32	321-0222-00			2 kΩ, 1/8 W, 1%
R36	321-0105-00			121 Ω, 1/8 W, 1%
R40	315-0202-00			2 kΩ, 1/4 W, 5%
R45	321-0275-00			7.15 kΩ, 1/8 W, 1%
R50	322-0085-00			75 Ω, 1/4 W, 1%

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R52	315-0102-00			1 kΩ, 1/4 W, 5%
R54	315-0563-00			56 kΩ, 1/4 W, 5%
R56	315-0103-00			10 kΩ, 1/4 W, 5%
R57	315-0103-00			10 kΩ, 1/4 W, 5%
R59	315-0100-00			10 Ω, 1/4 W, 5%
R60	321-0312-00			17.4 kΩ, 1/8 W, 1%
R62	315-0102-00			1 kΩ, 1/4 W, 5%
R64	315-0470-00			47 Ω, 1/4 W, 5%
R66	315-0182-00			1.8 kΩ, 1/4 W, 5%
R70	321-0277-00			7.5 kΩ, 1/8 W, 1%
R74	321-0235-00			2.74 kΩ, 1/8 W, 1%
R84	315-0102-00			1 kΩ, 1/4 W, 5%
R86	315-0470-00			47 Ω, 1/4 W, 5%
R134	321-0210-00			1.5 kΩ, 1/8 W, 1%
R138	315-0122-00			1.2 kΩ, 1/4 W, 5%
R140	315-0471-00			470 Ω, 1/4 W, 5%
R150	311-1261-00			500 Ω, Var
R151	315-0471-00			470 Ω, 1/4 W, 5%
R152	315-0153-00			15 kΩ, 1/4 W, 5%
R155	321-0293-00			11 kΩ, 1/8 W, 1%
R158	308-0252-00			390 Ω, 3 W, WW, 5%
R160	321-0235-00			2.74 kΩ, 1/8 W, 1%
R162	321-0251-00			4.02 kΩ, 1/8 W, 1%
R190	315-0472-00			4.7 kΩ, 1/4 W, 5%
R235	321-0247-00			3.65 kΩ, 1/8 W, 1%
• R240	315-0471-00			470 Ω, 1/4 W, 5%
R245	315-0122-00			1.2 kΩ, 1/4 W, 5%
R250	311-1263-00			1 kΩ, Var
R255	315-0472-00			4.7 kΩ, 1/4 W, 5%
R260	315-0270-00			27 Ω, 1/4 W, 5%
R280	322-0085-00			75 Ω, 1/4 W, 1%
R285	315-0101-00			100 Ω, 1/4 W, 5%
R289	315-0102-00			1 kΩ, 1/4 W, 5%
R301	315-0102-00			1 kΩ, 1/4 W, 5%
R329	315-0472-00			4.7 kΩ, 1/4 W, 5%
R335	321-0314-00			18.2 kΩ, 1/8 W, 1%
R336	315-0472-00			4.7 kΩ, 1/4 W, 5%
R337	315-0472-00			4.7 kΩ, 1/4 W, 5%
R339	315-0272-00			2.7 kΩ, 1/4 W, 5%
R350	311-1267-00			5 kΩ, Var
R352	315-0472-00			4.7 kΩ, 1/4 W, 5%
R354	315-0472-00			4.7 kΩ, 1/4 W, 5%
R356	315-0102-00			1 kΩ, 1/4 W, 5%
R380	315-0301-00			300 Ω, 1/4 W, 5%
R385	315-0392-00			3.9 kΩ, 1/4 W, 5%
R388	315-0101-00			100 Ω, 1/4 W, 5%
R501	315-0431-00			430 Ω, 1/4 W, 5%
R504	321-0176-00			665 Ω, 1/8 W, 1%
R505	311-1261-00			500 Ω, Var
R512	321-0157-00			422 Ω, 1/8 W, 1%

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R515	315-0122-00	B010100	B069999X	1.2 kΩ, 1/4 W, 5%
R520	315-0101-00	XB070000		100 Ω, 1/4 W, 5%
R525	315-0333-00			33 kΩ, 1/4 W, 5%
R526	321-0222-00			2 kΩ, 1/8 W, 1%
R528	315-0221-00			220 Ω, 1/4 W, 1%
R530	321-0222-00			2 kΩ, 1/8 W, 1%
R550	321-0152-00			374 Ω, 1/8 W, 1%
R552	315-0101-00			100 Ω, 1/4 W, 5%
R553	321-0296-00			11.8 kΩ, 1/8 W, 1%
R555	321-0085-00	B010100	B069999	75 Ω, 1/8 W, 1%
R555	321-0085-01	B070000		75 Ω, 1/8 W, 1/2%
R557	315-0102-00	B010100	B069999X	1 kΩ, 1/4 W, 5%
R562	315-0682-00			6.8 kΩ, 1/4 W, 5%
R566	321-0241-00			3.16 kΩ, 1/8 W, 1%
R568	315-0821-00	B010100	B069999X	820 Ω, 1/4 W, 5%
R576	315-0392-00	XB070000		3.9 kΩ, 1/4 W, 5%
R580	301-0102-00	B010100	B069999X	1 kΩ, 1/2 W, 5%
R583	315-0472-00	XB070000		4.7 kΩ, 1/4 W, 5%
R586	315-0911-00	XB070000		910 Ω, 1/4 W, 5%
R587	315-0152-00	XB070000		1.5 kΩ, 1/4 W, 5%
R588	315-0101-00	XB070000		100 Ω, 1/4 W, 5%
R592	315-0470-00	XB070000		47 Ω, 1/4 W, 5%
R594	315-0362-00	XB070000		3.6 kΩ, 1/4 W, 5%
R596	315-0561-00	XB070000		560 Ω, 1/4 W, 5%
R597	315-0911-00	XB070000		910 Ω, 1/4 W, 5%
R612	315-0682-00	XB070000		6.8 kΩ, 1/4 W, 5%
R615	315-0682-00	B010100	B069999X	6.8 kΩ, 1/4 W, 5%
R618	315-0106-00			10 MΩ, 1/4 W, 5%
R619	301-0102-00	B010100	B069999	1 kΩ, 1/2 W, 5%
R619	301-0681-00	B070000		680 Ω, 1/2 W, 5%
R625	321-0193-00			1 kΩ, 1/8 W, 1%
R627	315-0100-00	XB070000		100 Ω, 1/4 W, 5%
R630	315-0201-00	XB070000		200 Ω, 1/4 W, 5%
R642	321-0612-03			500 Ω, 1/8 W, 1/4%
R650	315-0183-00	B010100	B069999X	18 kΩ, 1/4 W, 5%
R652	315-0682-00	B010100	B069999X	6.8 kΩ, 1/4 W, 5%
R654	321-0171-00			590 Ω, 1/8 W, 1%
R658	315-0101-00			100 Ω, 1/4 W, 5%
R659	315-0182-00			1.8 kΩ, 1/4 W, 5%
R660	315-0561-00	XB070000		560 Ω, 1/4 W, 5%
R662	315-0153-00	XB070000		15 kΩ, 1/4 W, 5%
R668	315-0153-00	XB070000		15 kΩ, 1/4 W, 5%
R670	321-0171-00			590 Ω, 1/8 W, 1%
R674	315-0101-00			100 Ω, 1/4 W, 5%
R676	321-0612-03			500 Ω, 1/8 W, 1/4%
R677	315-0102-00	XB070000		1 kΩ, 1/4 W, 5%
R679	315-0470-00	B010100	B069999X	47 Ω, 1/4 W, 5%
R684	315-0470-00	XB070000		47 Ω, 1/4 W, 5%
R690	315-0752-00	B010100	B069999	7.5 kΩ, 1/4 W, 5%
R690	315-0911-00	B070000		910 Ω, 1/4 W, 5%

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R692	321-0085-00	B010100	B069999	75 Ω, 1/8 W, 1%
R692	321-0085-01	B070000		75 Ω, 1/8 W, 1/2%
R693	315-0392-00	XB070000		3.9 kΩ, 1/4 W, 5%
R694	315-0680-00			68 Ω, 1/4 W, 5%
R698	321-0085-00			75 Ω, 1/8 W, 1%
R707	315-0563-00	XB070000		56 kΩ, 1/4 W, 5%
R710	315-0470-00			47 Ω, 1/4 W, 5%
R711	315-0823-00			82 kΩ, 1/4 W, 5%
R713	315-0823-00			82 kΩ, 1/4 W, 5%
R714	315-0470-00			47 Ω, 1/4 W, 5%
R716	315-0823-00			82 kΩ, 1/4 W, 5%
R717	315-0470-00	B010100	B069999X	47 Ω, 1/4 W, 5%
R718	315-0203-00	B010100	B069999	20 kΩ, 1/4 W, 5%
R718	315-0183-00	B070000		18 kΩ, 1/4 W, 5%
R720	315-0470-00			47 Ω, 1/4 W, 5%
R735	311-1272-00			100 kΩ, Var
R740	315-0102-00	XB070000		1 kΩ, 1/4 W, 5%
R748	321-0612-03			500 Ω, 1/8 W, 1/4%
R749	315-0182-00			1.8 kΩ, 1/4 W, 5%
R750	321-0131-00			226 Ω, 1/8 W, 1%
R754	315-0182-00			1.8 kΩ, 1/4 W, 5%
R756	321-0178-00			698 Ω, 1/8 W, 1%
R757	321-0126-00			200 Ω, 1/8 W, 1%
R759	321-0126-00			200 Ω, 1/8 W, 1%
R765	311-1260-00			250 Ω, Var
R766	315-0431-00			430 Ω, 1/4 W, 5%
R770	315-0101-00			100 Ω, 1/4 W, 5%
R772	321-0612-03			500 Ω, 1/8 W, 1/4%
R773	315-0123-00			12 kΩ, 1/4 W, 5%
R774	321-0131-00			226 Ω, 1/8 W, 1%
R775	311-1271-00			50 kΩ, Var
R785	311-1271-00			50 kΩ, Var
R786	315-0333-00			33 kΩ, 1/4 W, 5%
R790	301-0821-00			820 Ω, 1/2 W, 5%
R797	307-0103-00			2.7 Ω, 1/4 W, 5%
R806	315-0102-00			1 kΩ, 1/4 W, 5%
R807	315-0472-00	B010100	B069999X	4.7 kΩ, 1/4 W, 5%
R808	315-0472-00	XB070000		4.7 kΩ, 1/4 W, 5%
R810	315-0682-00	B010100	B069999X	6.8 kΩ, 1/4 W, 5%
R815	315-0681-00	B010100	B069999X	680 Ω, 1/4 W, 5%
R817	321-0372-00			73.2 kΩ, 1/8 W, 1%
R819	321-0374-00			76.8 kΩ, 1/8 W, 1%
R820	315-0474-00	XB070000		470 kΩ, 1/4 W, 5%
R821	315-0101-00			100 Ω, 1/4 W, 5%
R824	315-0682-00	B010100	B069999X	6.8 kΩ, 1/4 W, 5%
R840	321-0238-00			2.94 kΩ, 1/8 W, 1%
R842	321-0165-00			511 Ω, 1/8 W, 1%
R843	321-0258-00			4.75 kΩ, 1/8 W, 1%

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R845	315-0470-00			47 Ω, 1/4 W, 5%
R847	321-0612-03	XB070000		500 Ω, 1/8 W, 1/4%
R848	321-0612-03	B010100	B069999	500 Ω, 1/8 W, 1/4%
R848	315-0470-00	B070000		47 Ω, 1/4 W, 5%
R849	315-0470-00	B010100	B069999	47 Ω, 1/4 W, 5%
R849	315-0102-00	B070000		1 kΩ, 1/4 W, 5%
R850	321-0171-00			590 Ω, 1/8 W, 1%
R854	315-0101-00			100 Ω, 1/4 W, 5%
R856	315-0182-00			1.8 kΩ, 1/4 W, 5%
R862	315-0221-00	XB070000		220 Ω, 1/4 W, 5%
R863	321-0239-00			3.01 kΩ, 1/8 W, 1%
R868	321-0210-00			1.5 kΩ, 1/8 W, 1%
R870	321-0171-00			590 Ω, 1/8 W, 1%
R872	315-0101-00			100 Ω, 1/4 W, 5%
R874	321-0612-03			500 Ω, 1/8 W, 1/4%
R876	315-0470-00			47 Ω, 1/4 W, 5%
R883	301-0122-00			1.2 kΩ, 1/2 W, 5%
R888	315-0102-00	XB070000		1 kΩ, 1/4 W, 5%
R890	315-0362-00			3.6 kΩ, 1/4 W, 5%
R891	315-0241-00	B010100	B069999X	240 Ω, 1/4 W, 5%
R893	315-0151-00	XB070000		150 Ω, 1/4 W, 5%
R895	315-0472-00	B010100	B069999	4.7 kΩ, 1/4 W, 5%
R895	311-1261-00	B070000		500 Ω, Var
R896	321-0085-00			75 Ω, 1/8 W, 1%
R897	321-0085-00			75 Ω, 1/8 W, 1%
R898	301-0821-00			820 Ω, 1/2 W, 5%
R906	315-0470-00	B010100	B069999	47 Ω, 1/4 W, 5%
R906	315-0682-00	B070000		6.8 kΩ, 1/4 W, 5%
R908	315-0470-00			47 Ω, 1/4 W, 5%
R910	315-0332-00			3.3 kΩ, 1/4 W, 5%
R912	315-0202-00			2 kΩ, 1/4 W, 5%
R915	315-0332-00			3.3 kΩ, 1/4 W, 5%
R917	315-0102-00			1 kΩ, 1/4 W, 5%
R919	315-0273-00	B010100	B069999	27 kΩ, 1/4 W, 5%
R919	315-0153-00	B070000		15 kΩ, 1/4 W, 5%
R920	315-0100-00			10 Ω, 1/4 W, 5%
R926	315-0393-00	B010100	B069999	39 kΩ, 1/4 W, 5%
R926	315-0563-00	B070000		56 kΩ, 1/4 W, 5%
R928	315-0221-00			220 Ω, 1/4 W, 5%
R940	321-0612-03			500 Ω, 1/8 W, 1/4%
R942	315-0182-00			1.8 kΩ, 1/4 W, 5%
R943	321-0131-00			226 Ω, 1/8 W, 1%
R950	321-0178-00			698 Ω, 1/8 W, 1%
R952	315-0182-00			1.8 kΩ, 1/4 W, 5%
R954	321-0126-00			200 Ω, 1/8 W, 1%
R955	321-0126-00			200 Ω, 1/8 W, 1%
R957	321-0238-00			2.94 kΩ, 1/8 W, 1%
R958	321-0165-00			511 Ω, 1/8 W, 1%

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R959	321-0258-00			4.75 kΩ, 1/8 W, 1%
R963	311-1260-00	XB070000		250 Ω, Var
R965	311-1260-00			250 Ω, Var
R966	315-0431-00			430 Ω, 1/4 W, 5%
R969	315-0241-00	B010100	B069999	240 Ω, 1/4 W, 5%
R969	315-0221-00	B070000		220 Ω, 1/4 W, 5%
R970	315-0101-00			100 Ω, 1/4 W, 5%
R971	321-0612-03			500 Ω, 1/8 W, 1/4%
R972	315-0123-00			12 kΩ, 1/4 W, 5%
R973	321-0131-00			226 Ω, 1/8 W, 1%
R975	311-1271-00			50 kΩ, Var
R976	315-0333-00			33 kΩ, 1/4 W, 5%
R977	321-0239-00			3.01 kΩ, 1/8 W, 1%
R978	321-0210-00			1.5 kΩ, 1/8 W, 1%
R979	301-0122-00			1.2 kΩ, 1/2 W, 5%
R983	315-0151-00			150 Ω, 1/4 W, 5%
R985	311-1271-00			50 kΩ, Var
R993	307-0103-00			2.7 Ω, 1/4 W, 5%
R994	315-0680-00			68 Ω, 1/4 W, 5%
R995	315-0362-00			3.6 kΩ, 1/4 W, 5%
R996	315-0151-00			150 Ω, 1/4 W, 5%
R997	315-0241-00	XB070000		240 Ω, 1/4 W, 5%
R1000	315-0102-00			1 kΩ, 1/4 W, 5%
R1098	315-0102-00			1 kΩ, 1/4 W, 5%
R1350	315-0103-00			10 kΩ, 1/4 W, 5%
R1365	315-0102-00			1 kΩ, 1/4 W, 5%
R1395	315-0102-00			1 kΩ, 1/4 W, 5%
R1400	315-0185-00			1.8 MΩ, 1/4 W, 5%
R1401	315-0472-00			4.7 kΩ, 1/4 W, 5%
R1420	315-0103-00			10 kΩ, 1/4 W, 5%
R1430	315-0472-00			4.7 kΩ, 1/4 W, 5%
R1501	315-0275-00			2.7 MΩ, 1/4 W, 5%
R1502	315-0332-00			3.3 kΩ, 1/4 W, 5%
R1520	315-0333-00			33 kΩ, 1/4 W, 5%
R1530	315-0472-00			4.7 kΩ, 1/4 W, 5%
R1601	321-0255-00			4.42 kΩ, 1/8 W, 1%
R1602	321-0270-00			6.34 kΩ, 1/8 W, 1%
R1630	315-0392-00			3.9 kΩ, 1/4 W, 5%
R1631	315-0103-00			10 kΩ, 1/4 W, 5%
R1632	315-0392-00			3.9 kΩ, 1/4 W, 5%
R1650	315-0102-00			1 kΩ, 1/4 W, 5%
R1655	315-0202-00			2 kΩ, 1/4 W, 5%
R1695	315-0181-00			180 Ω, 1/4 W, 5%
R1701	315-0513-00			51 kΩ, 1/4 W, 5%
R1710	315-0102-00			1 kΩ, 1/4 W, 5%
R1715	315-0222-00			2.2 kΩ, 1/4 W, 5%
R1720	315-0153-00			15 kΩ, 1/4 W, 5%
R1721	315-0124-00			120 kΩ, 1/4 W, 5%
R1725	315-0473-00			47 kΩ, 1/4 W, 5%
R1730	315-0474-00			470 kΩ, 1/4 W, 5%
R1732	315-0155-00			1.5 MΩ, 1/4 W, 5%
R1735	315-0332-00			3.3 kΩ, 1/4 W, 5%
R1740	315-0102-00			1 kΩ, 1/4 W, 5%

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R1750	315-0271-00			270 Ω, 1/4 W, 5%
R1755	315-0622-00			6.2 kΩ, 1/4 W, 5%
R1760	315-0472-00			4.7 kΩ, 1/4 W, 5%
R1791	315-0103-00			10 kΩ, 1/4 W, 5%
R1793	315-0333-00			33 kΩ, 1/4 W, 5%
R1795	315-0391-00			390 Ω, 1/4 W, 5%
R1798	315-0821-00			820 Ω, 1/4 W, 5%
R1799	315-0223-00			22 kΩ, 1/4 W, 5%
R1805	315-0113-00			11 kΩ, 1/4 W, 5%
R1810	321-0255-00			4.42 kΩ, 1/8 W, 1%
R1820	321-0270-00			6.34 kΩ, 1/8 W, 1%
R1830	315-0472-00			4.7 kΩ, 1/4 W, 5%
R1835	315-0122-00			1.2 kΩ, 1/4 W, 5%
R1840	315-0472-00			4.7 kΩ, 1/4 W, 5%
R1890	315-0333-00			33 kΩ, 1/4 W, 5%
R1893	321-0312-00			17.4 kΩ, 1/8 W, 1%
R1900	315-0432-00			4.3 kΩ, 1/4 W, 5%
R1903	315-0272-00			2.7 kΩ, 1/4 W, 5%
R1930	315-0154-00			150 kΩ, 1/4 W, 5%
R1935	315-0332-00			3.3 kΩ, 1/4 W, 5%
R1940	315-0471-00			470 Ω, 1/4 W, 5%
R1950	315-0473-00			47 kΩ, 1/4 W, 5%
R1955	315-0473-00			47 kΩ, 1/4 W, 5%
R1988	311-1268-00			10 kΩ, Var
R1990	315-0101-00			100 Ω, 1/4 W, 5%
R1991	315-0101-00			100 Ω, 1/4 W, 5%
R1998	315-0240-00			24 Ω, 1/4 W, 5%
R2701	315-0102-00			1 kΩ, 1/4 W, 5%
R2703	321-0272-00			6.65 kΩ, 1/8 W, 1%
R2705	315-0103-00			10 kΩ, 1/4 W, 5%
R2715	311-0633-00			5 kΩ, Var
R2720	321-0299-00			12.7 kΩ, 1/8 W, 1%
R2882	315-0272-00			2.7 kΩ, 1/4 W, 5%
R2910	315-0272-00			2.7 kΩ, 1/4 W, 5%
R2915	315-0102-00			1 kΩ, 1/4 W, 5%
R2918	315-0471-00			470 Ω, 1/4 W, 5%
R2920	315-0272-00			2.7 kΩ, 1/4 W, 5%
R2922	315-0272-00			2.7 kΩ, 1/4 W, 5%
R2932	315-0272-00			2.7 kΩ, 1/4 W, 5%
R2934	315-0272-00			2.7 kΩ, 1/4 W, 5%
R2970	315-0102-00			1 kΩ, 1/4 W, 5%
R2980	315-0272-00			2.7 kΩ, 1/4 W, 5%
R3001	321-0306-00			15 kΩ, 1/8 W, 1%
R3003	315-0272-00			2.7 kΩ, 1/4 W, 5%
R3005	315-0470-00			47 Ω, 1/4 W, 5%
R3007	315-0102-00			1 kΩ, 1/4 W, 5%
R3013	315-0123-00			12 kΩ, 1/4 W, 5%
R3021	321-0082-00			69.8 Ω, 1/8 W, 1%
R3031	321-0068-00			49.9 Ω, 1/8 W, 1%
R3041	315-0152-00			1.5 kΩ, 1/4 W, 5%

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R3043	315-0152-00			1.5 kΩ, 1/4 W, 5%
R3051	315-0223-00			22 kΩ, 1/4 W, 5%
R3061	315-0152-00			1.5 kΩ, 1/4 W, 5%
R3071	315-0152-00			1.5 kΩ, 1/4 W, 5%
R3081	315-0223-00			22 kΩ, 1/4 W, 5%
R3083	315-0472-00			4.7 kΩ, 1/4 W, 5%
R3121	307-0103-00			2.7 Ω, 1/4 W, 5%
R3123	315-0152-00			1.5 kΩ, 1/4 W, 5%
R3125	315-0103-00			10 kΩ, 1/4 W, 5%
R3126	315-0392-00			3.9 kΩ, 1/4 W, 5%
R3141	315-0180-00			18 Ω, 1/4 W, 5%
R3151	315-0223-00			22 kΩ, 1/4 W, 5%
R3153	315-0470-00			47 Ω, 1/4 W, 5%
R3161	315-0223-00			22 kΩ, 1/4 W, 5%
R3163	315-0470-00			47 Ω, 1/4 W, 5%
R3165	315-0102-00			1 kΩ, 1/4 W, 5%
R3171	315-0181-00			180 Ω, 1/4 W, 5%
R3181	315-0103-00			10 kΩ, 1/4 W, 5%
R3183	315-0222-00			2.2 kΩ, 1/4 W 5%
R3185	315-0102-00			1 kΩ, 1/4 W, 5%
R3186	315-0682-00			6.8 kΩ, 1/4 W, 5%
R3211	315-0511-00			510 Ω, 1/4 W, 5%
R3221	315-0242-00			2.4 kΩ, 1/4 W, 5%
R3223	315-0100-00			10 Ω, 1/4 W, 5%
R3225	315-0470-00			47 Ω, 1/4 W, 5%
R3227	315-0222-00			2.2 kΩ, 1/4 W, 5%
R3241	315-0102-00			1 kΩ, 1/4 W, 5%
R3260	311-1225-00			1 kΩ, Var
R3270	311-1230-00			20 kΩ, Var
R3271	321-0222-00			2 kΩ, 1/8 W, 1%
R3281	315-0102-00			1 kΩ, 1/4 W, 5%
R3283	315-0472-00			4.7 kΩ, 1/4 W, 5%
R3285	315-0153-00			15 kΩ, 1/4 W, 5%
R3311	321-0323-00			22.6 kΩ, 1/8 W, 1%
R3321	315-0511-00			510 Ω, 1/4 W, 5%
R3323	315-0470-00			47 Ω, 1/4 W, 5%
R3325	315-0471-00			470 Ω, 1/4 W, 5%
R3331	315-0471-00			470 Ω, 1/4 W, 5%
R3335	315-0202-00			2 kΩ, 1/4 W, 5%
R3337	321-0352-00			45.3 kΩ, 1/8 W, 1%
R3341	321-0222-00			2 kΩ, 1/8 W, 1%
R3343	321-0081-00			68.1 Ω, 1/8 W, 1%
R3345	315-0392-00			3.9 kΩ, 1/4 W, 5%
R3353	315-0392-00			3.9 kΩ, 1/4 W, 5%
R3371	321-0081-00			68.1 Ω, 1/8 W, 1%
R3373	315-0132-00			1.3 kΩ, 1/4 W, 5%
R3381	315-0220-00			22 Ω, 1/4 W, 5%
R3383	315-0153-00			15 kΩ, 1/4 W, 5%
R3385	315-0101-00			100 Ω, 1/4 W, 5%
R3410	311-1230-00			20 kΩ, Var
R3411	315-0101-00			100 Ω, 1/4 W, 5%
R3420	311-1230-00			20 kΩ, Var
R3431	315-0272-00			2.7 kΩ, 1/4 W, 5%
R3450	315-0752-00			7.5 kΩ, 1/4 W, 5%
R3451	315-0104-00			100 kΩ, 1/4 W, 5%

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R3453	315-0331-00			330 Ω, 1/4 W, 5%
R3481	315-0272-00			2.7 kΩ, 1/4 W, 5%
R3491	315-0472-00			4.7 kΩ, 1/4 W, 5%
R3511	321-0216-00			1.74 kΩ, 1/8 W, 1%
R3513	315-0512-00			5.1 kΩ, 1/4 W, 5%
R3515	315-0562-00			5.6 kΩ, 1/4 W, 5%
R3517	315-0392-00			3.9 kΩ, 1/4 W, 5%
R3521	315-0153-00			15 kΩ, 1/4 W, 5%
R3523	315-0100-00			10 Ω, 1/4 W, 5%
R3531	315-0563-00			56 kΩ, 1/4 W, 5%
R3541	315-0682-00			6.8 kΩ, 1/4 W, 5%
R3553	315-0103-00			10 kΩ, 1/4 W, 5%
R3555	315-0104-00			100 kΩ, 1/4 W, 5%
R3557	315-0331-00			330 Ω, 1/4 W, 5%
R3581	315-0153-00			15 kΩ, 1/4 W, 5%
R3583	315-0153-00			15 kΩ, 1/4 W, 5%
R3585	315-0182-00			1.8 kΩ, 1/4 W, 5%
R3610	315-0470-00			47 Ω, 1/4 W, 5%
R3616	311-1230-00			20 kΩ, Var
R3621	321-0353-00			46.4 kΩ, 1/8 W, 1%
R3623	315-0100-00			10 Ω, (nominal value) Selected
R3625	315-0102-00			1 kΩ, 1/4 W, 5%
R3641	321-0297-00			12.1 kΩ, 1/8 W, 1%
R3661	315-0272-00			2.7 kΩ, 1/4 W, 5%
R3663	315-0272-00			2.7 kΩ, 1/4 W, 5%
R3671	315-0272-00			2.7 kΩ, 1/4 W, 5%
R3711	321-0262-00			5.23 kΩ, 1/8 W, 1%
R3713	315-0102-00			1 kΩ, 1/4 W, 5%
R3791	316-0225-00			2.2 MΩ, 1/4 W, 10%
R3793	316-0225-00			2.2 MΩ, 1/4 W, 10%
R3795	315-0752-00			7.5 kΩ, 1/4 W, 5%
R3811	321-0266-00			5.76 kΩ, 1/8 W, 1%
R3813	321-0358-00			52.3 kΩ, 1/8 W, 1%
R3814	315-0100-00			10 Ω, 1/4 W, 5%
R3840	315-0472-00			4.7 kΩ, 1/4 W, 5%
R3890	315-0513-00			51 kΩ, 1/4 W, 5%
R3911	315-0102-00			1 kΩ, 1/4 W, 5%
R3913	321-0262-00			5.23 kΩ, 1/8 W, 1%
R3961	315-0472-00			4.7 kΩ, 1/4 W, 5%
R3993	315-0472-00			4.7 kΩ, 1/4 W, 5%
R3995	315-0472-00			4.7 kΩ, 1/4 W, 5%
R3997	315-0472-00			4.7 kΩ, 1/4 W, 5%
R4174	315-0102-00			1 kΩ, 1/4 W, 5%
R4184	315-0472-00			4.7 kΩ, 1/4 W, 5%
R4188	315-0272-00			2.7 kΩ, 1/4 W, 5%
R4250	315-0102-00			1 kΩ, 1/4 W, 5%
R4254	315-0272-00			2.7 kΩ, 1/4 W, 5%
R4260	315-0272-00			2.7 kΩ, 1/4 W, 5%
R4270	315-0102-00			1 kΩ, 1/4 W, 5%
R4272	315-0102-00			1 kΩ, 1/4 W, 5%
R4280	315-0272-00			2.7 kΩ, 1/4 W, 5%
R4290	315-0272-00			2.7 kΩ, 1/4 W, 5%
R4370	315-0102-00			1 kΩ, 1/4 W, 5%
R4390	315-0472-00			4.7 kΩ, 1/4 W, 5%
R4468	315-0102-00			1 kΩ, 1/4 W, 5%

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ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R4470	315-0102-00			1 kΩ, 1/4 W, 5%
R4484	315-0472-00			4.7 kΩ, 1/4 W, 5%
R4486	315-0472-00			4.7 kΩ, 1/4 W, 5%
R4488	315-0332-00			3.3 kΩ, 1/4 W, 5%
R4550	315-0102-00			1 kΩ, 1/4 W, 5%
R4728	315-0102-00			1 kΩ, 1/4 W, 5%
R4768	315-0102-00			1 kΩ, 1/4 W, 5%
R4772	315-0102-00			1 kΩ, 1/4 W, 5%
R4776	315-0102-00			1 kΩ, 1/4 W, 5%
R4780	315-0102-00			1 kΩ, 1/4 W, 5%
R4786	315-0102-00			1 kΩ, 1/4 W, 5%
R4840	315-0102-00	B010100	B069999X	1 kΩ, 1/4 W, 5%
R4920	315-0102-00			1 kΩ, 1/4 W, 5%
R4922	315-0102-00			1 kΩ, 1/4 W, 5%
R4960	315-0102-00			1 kΩ, 1/4 W, 5%
R4996	315-0102-00			1 kΩ, 1/4 W, 5%
R5018	315-0153-00			15 kΩ, 1/4 W, 5%
R5020	315-0272-00			2.7 kΩ, 1/4 W, 5%
R5022	315-0392-00			3.9 kΩ, 1/4 W, 5%
R5030	315-0822-00			8.2 kΩ, 1/4 W, 5%
R5033	315-0333-00			33 kΩ, 1/4 W, 5%
R5042	315-0153-00			15 kΩ, 1/4 W, 5%
R5044	315-0241-00			240 Ω, 1/4 W, 5%
R5046	315-0272-00			2.7 kΩ, 1/4 W, 5%
R5049	315-0562-00			5.6 kΩ, 1/4 W, 5%
R5050	315-0430-00			43 Ω, 1/4 W, 5%
R5052	315-0102-00			1 kΩ, 1/4 W, 5%
R5055	315-0752-00			7.5 kΩ, 1/4 W, 5%
R5060	315-0391-00			390 Ω, 1/4 W, 5%
R5065	315-0241-00			240 Ω, 1/4 W, 5%
R5070	315-0100-00			10 Ω, 1/4 W, 5%
R5074	315-0102-00			1 kΩ, 1/4 W, 5%
R5075	315-0113-00			11 kΩ, 1/4 W, 5%
R5076	315-0153-00			15 kΩ, 1/4 W, 5%
R5080	315-0274-00			270 kΩ, 1/4 W, 5%
R5081	315-0914-00			910 kΩ, 1/4 W, 5%
R5089	315-0473-00			47 kΩ, 1/4 W, 5%
R5115	315-0331-00			330 Ω, 1/4 W, 5%
R5131	315-0103-00			10 kΩ, 1/4 W, 5%
R5135	315-0470-00			47 Ω, 1/4 W, 5%
R5138	315-0271-00			270 Ω, 1/4 W, 5%
R5140	315-0433-00			43 kΩ, 1/4 W, 5%
R5155	315-0432-00			4.3 kΩ, 1/4 W, 5%
R5157	315-0153-00			15 kΩ, 1/4 W, 5%
R5160	321-0338-00			32.4 kΩ, 1/8 W, 1%
R5162	315-0333-00	B010100	B059999	33 kΩ, 1/4 W, 5%
R5162	315-0243-00	B060000		24 kΩ, 1/4 W, 5%
R5165	315-0103-00			10 kΩ, 1/4 W, 5%
R5175	315-0153-00			15 kΩ, 1/4 W, 5%
R5178	315-0393-00			39 kΩ, 1/4 W, 5%
R5185	315-0301-00			300 Ω, 1/4 W, 5%

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ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R5193	315-0274-00			270 kΩ, 1/4 W, 5%
R5215	315-0361-00			360 Ω, 1/4 W, 5%
R5218	315-0183-00			18 kΩ, 1/4 W, 5%
R5220	315-0472-00			4.7 kΩ, 1/4 W, 5%
R5240	315-0153-00			15 kΩ, 1/4 W, 5%
R5245	315-0472-00			4.7 kΩ, 1/4 W, 5%
R5247	315-0561-00			560 Ω, 1/4 W, 5%
R5249	315-0361-00			360 Ω, 1/4 W, 5%
R5260	315-0472-00			4.7 kΩ, 1/4 W, 5%
R5265	315-0332-00			3.3 kΩ, 1/4 W, 5%
R5268	315-0561-00			560 Ω, 1/4 W, 5%
R5269	315-0361-00			360 Ω, 1/4 W, 5%
R5270	315-0272-00	B010100	B059999	2.7 kΩ, 1/4 W, 5%
R5270	315-0152-00	B060000		1.5 kΩ, 1/4 W, 5%
R5285	315-0152-00			1.5 kΩ, 1/4 W, 5%
R5315	315-0153-00			15 kΩ, 1/4 W, 5%
R5325	321-0181-00			750 Ω, 1/8 W, 1%
R5345	315-0361-00			360 Ω, 1/4 W, 5%
R5348	315-0153-00			15 kΩ, 1/4 W, 5%
R5350	321-0281-00			8.25 kΩ, 1/8 W, 1%
R5355	321-0281-00			8.25 kΩ, 1/8 W, 1%
R5357	315-0242-00			2.4 kΩ, 1/4 W, 5%
R5360	315-0102-00			1 kΩ, 1/4 W, 5%
R5362	315-0102-00			1 kΩ, 1/4 W, 5%
R5370	315-0152-00	B010100	B059999	1.5 kΩ, 1/4 W, 5%
R5370	315-0102-00	B060000		1 kΩ, 1/4 W, 5%
R5375	315-0623-00			62 kΩ, 1/4 W, 5%
R5380	315-0152-00			1.5 kΩ, 1/4 W, 5%
R5385	315-0102-00			1 kΩ, 1/4 W, 5%
R5398	315-0103-00			10 kΩ, 1/4 W, 5%
R5401	321-0181-00			750 Ω, 1/8 W, 1%
R5420	315-0102-00			1 kΩ, 1/4 W, 5%
R5425	315-0102-00			1 kΩ, 1/4 W, 5%
R5430	315-0122-00			1.2 kΩ, 1/4 W, 5%
R5440	315-0361-00			360 Ω, 1/4 W, 5%
R5442	315-0153-00			15 kΩ, 1/4 W, 5%
R5455	315-0181-00			180 Ω, 1/4 W, 5%
R5461	315-0473-00			47 kΩ, 1/4 W, 5%
R5465	321-0193-00			1 kΩ, 1/8 W, 1%
R5470	315-0153-00			15 kΩ, 1/4 W, 5%
R5472	321-0193-00			1 kΩ, 1/8 W, 1%
R5474	315-0153-00			15 kΩ, 1/4 W, 5%
R5476	315-0153-00			15 kΩ, 1/4 W, 5%
R5490	315-0102-00			1 kΩ, 1/4 W, 5%
R5520	315-0330-00			33 Ω, 1/4 W, 5%
R5525	315-0122-00			1.2 kΩ, 1/4 W, 5%
R5530	315-0101-00			100 Ω, 1/4 W, 5%
R5540	315-0181-00			180 Ω, 1/4 W, 5%
R5542	315-0242-00			2.4 kΩ, 1/4 W, 5%
R5545	315-0101-00			100 Ω, 1/4 W, 5%
R5550	315-0101-00			100 Ω, 1/4 W, 5%
R5560	315-0101-00			100 Ω, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R5562	315-0101-00			100 Ω, 1/4 W, 5%
R5568	315-0152-00			1.5 kΩ, 1/4 W, 5%
R5570	315-0473-00			47 kΩ, 1/4 W, 5%
R5575	315-0470-00			47 Ω, 1.4 W, 5%
R5580	315-0152-00			1.5 kΩ, 1/4 W, 5%
R5582	315-0303-00			30 kΩ, 1/4 W, 5%
R5584	315-0151-00			150 Ω, 1/4 W, 5%
R5590	315-0201-00			200 Ω, 1/4 W, 5%
R5595	315-0151-00			150 Ω, 1/4 W, 5%
R5610	315-0331-00			330 Ω, 1/4 W, 5%
R5618	315-0101-00			100 Ω, 1/4 W, 5%
R5635	321-0193-00			1 kΩ, 1/8 W, 1%
R5640	321-0193-00			1 kΩ, 1/8 W, 1%
R5642	315-0363-00			36 kΩ, 1/4 W, 5%
R5665	315-0152-00			1.5 kΩ, 1/4 W, 5%
R5670	315-0153-00			15 kΩ, 1/4 W, 5%
R5672	315-0153-00			15 kΩ, 1/4 W, 5%
R5685	315-0201-00			200 Ω, 1/4 W, 5%
R5701	315-0100-00			10 Ω, 1/4 W, 5%
R5710	315-0153-00			15 kΩ, 1/4 W, 5%
R5720	315-0472-00			4.7 kΩ, 1/4 W, 5%
R5722	315-0433-00			43 kΩ, 1/4 W, 5%
R5735	315-0753-00			75 kΩ, 1/4 W, 5%
R5740	315-0154-00			150 kΩ, 1/4 W, 5%
R5742	315-0754-00			750 kΩ, 1/4 W, 5%
R5744	315-0152-00			1.5 kΩ, 1/4 W, 5%
R5746	315-0512-00			5.1 kΩ, 1/4 W, 5%
R5750	315-0823-00			82 kΩ, 1/4 W, 5%
R5755	315-0104-00			100 kΩ, 1/4 W, 5%
R5758	316-0825-00			8.2 MΩ, 1/4 W, 10%
R5760	315-0102-00			1 kΩ, 1/4 W, 5%
R5770	315-0473-00			47 kΩ, 1/4 W, 5%
R5772	315-0751-00			750 Ω, 1/4 W, 5%
R5775	315-0104-00			100 kΩ, 1/4 W, 5%
R5780	315-0243-00			24 kΩ, 1/4 W, 5%
R5781	315-0391-00			390 Ω, 1/4 W, 5%
R5784	321-0371-00			71.5 kΩ, 1/8 W, 1%
R5785	321-0331-00			27.4 kΩ, 1/8 W, 1%
R5788	321-0318-00			20 kΩ, 1/8 W, 1%
R5790	315-0473-00			47 kΩ, 1/4 W, 5%
R5792	321-0371-00			71.5 kΩ, 1/8 W, 1%
R5794	321-0318-00			200 kΩ, 1/8 W, 1%
R5798	315-0473-00			47 kΩ, 1/4 W, 5%
R5801	315-0152-00			1.5 kΩ, 1/4 W, 5%
R5818	315-0101-00			100 Ω, 1/4 W, 5%
R5820	315-0222-00			2.2 kΩ, 1/4 W, 5%
R5825	315-0103-00			10 kΩ, 1/4 W, 5%
R5830	315-0220-00			22 Ω, 1/4 W, 5%
R5832	315-0152-00			1.5 kΩ, 1/4 W, 5%
R5834	315-0750-00			75 Ω, 1/4 W, 5%
R5840	315-0124-00			120 kΩ, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R5841	315-0622-00			6.2 kΩ, 1/4 W, 5%
R5845	315-0272-00			2.7 kΩ, 1/4 W, 5%
R5865	315-0103-00			10 kΩ, 1/4 W, 5%
R5868	315-0103-00			10 kΩ, 1/4 W, 5%
R5870	315-0475-00			4.7 MΩ, 1/4 W, 5%
R5872	321-0252-00			4.12 kΩ, 1/8 W, 1%
R5875	321-0220-00			1.91 kΩ, 1/8 W, 1%
R5877	315-0682-00			6.8 kΩ, 1/4 W, 5%
R5878	321-0335-00			30.1 kΩ, 1/8 W, 1%
R5880	321-0705-00			41.7 kΩ, 1/8 W, 1%
R5882	315-0474-00			470 kΩ, 1/4 W, 5%
R5884	321-0335-00			30.1 kΩ, 1/8 W, 1%
R5890	321-0331-00			27.4 kΩ, 1/8 W, 1%
R5892	321-0705-00			41.7 kΩ, 1/8 W, 1%
R5910	321-0277-00			7.5 kΩ, (nominal value) Selected
R5920	321-0231-00			2.49 kΩ, (nominal value) Selected
R5929	311-1267-00			5 kΩ, Var
R5933	315-0202-00			2 kΩ, 1/4 W, 5%
R5935	315-0124-00			120 kΩ, 1/4 W, 5%
R5940	315-0473-00			47 kΩ, 1/4 W, 5%
R5945	315-0393-00			39 kΩ, 1/4 W, 5%
R5950	315-0202-00			2 kΩ, 1/4 W, 5%
R5965	315-0333-00			33 kΩ, 1/4 W, 5%
R5968	315-0153-00			15 kΩ, 1/4 W, 5%
R5970	315-0104-00			100 kΩ, 1/4 W, 5%
R5975	315-0472-00			4.7 kΩ, 1/4 W, 5%
R5990	315-0392-00			3.9 kΩ, 1/4 W, 5%
R5994	321-0306-00			15 kΩ, 1/8 W, 1%
R5998	321-0373-00			75 kΩ, 1/8 W, 1%
R6005	315-0472-00			4.7 kΩ, 1/4 W, 5%
R6008	315-0103-00			10 kΩ, 1/4 W, 5%
R6071	315-0470-00			47 Ω, 1/4 W, 5%
R6075	315-0470-00			47 Ω, 1/4 W, 5%
R6082	315-0270-00			27 Ω, 1/4 W, 5%
R6083	315-0202-00			2 kΩ, 1/4 W, 5%
R6086	315-0100-00			10 Ω, 1/4 W, 5%
R6098	315-0302-00			3 kΩ, 1/4 W, 5%
R6108	315-0103-00			10 kΩ, 1/4 W, 5%
R6117	321-0375-00	B010100	B069999	78.7 kΩ, 1/8 W, 1%
R6117	321-0368-00	B070000		66.5 kΩ, 1/8 W, 1%
R6119	321-0321-00	B010100	B069999	21.5 kΩ, 1/8 W, 1%
R6119	321-0313-00	B070000		17.8 kΩ, 1/8 W, 1%
R6122	321-0297-00			12.1 kΩ, 1/8 W, 1%
R6128	321-0261-00			5.11 kΩ, 1/8 W, 1%
R6132	321-0260-00			4.99 kΩ, 1/8 W, 1%
R6136	321-0251-00			4.02 kΩ, 1/8 W, 1%
R6142	321-0421-00			237 kΩ, 1/8 W, 1%
R6144	321-0239-00	B010100	B069999	3.01 kΩ, 1/8 W, 1%
R6144	321-0236-00	B070000		2.8 kΩ, 1/8 W, 1%
R6148	315-0103-00			10 kΩ, 1/4 W, 5%
R6152	315-0102-00			1 kΩ, 1/4 W, 5%
R6154	315-0103-00			10 kΩ, 1/4 W, 5%
R6158	322-0210-00			1.5 kΩ, 1/4 W, 1%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R6164	323-0181-00			750 Ω, 1/2 W, 1%
R6195	315-0202-00			2 kΩ, 1/4 W, 5%
R6202	311-1268-00	B010100	B069999	10 kΩ, Var
R6202	311-0644-00	B070000		20 kΩ, Var
R6249	321-0410-00			182 kΩ, (nominal value) Selected
R6284	315-0100-00			10 Ω, 1/4 W, 5%
R6288	315-0332-00			3.3 kΩ, 1/4 W, 5%
R6304	311-1269-00			20 kΩ, Var
R6314	311-1267-00			5 kΩ, Var
R6324	301-1267-00			5 kΩ, Var
R6334	311-1260-00			2.5 kΩ, Var
R6344	311-1266-00			2.5 kΩ, Var
R6354	311-1271-00			50 kΩ, Var
R6362	311-1273-00			200 kΩ, Var
R6363	315-0224-00			220 kΩ, 1/4 W, 5%
R6364	315-0104-00			100 kΩ, 1/4 W, 5%
R6368	321-0829-07			202 Ω, 1/8 W, 1/10%
R6370	321-0829-07			202 Ω, (nominal value) Selected
R6375	Selected			
R6384	315-0162-00			1.6 kΩ, 1/4 W, 5%
R6392	315-0102-00			1 kΩ, 1/4 W, 5%
R6395	315-0102-00			1 kΩ, 1/4 W, 5%
R6398	315-0391-00			390 Ω, 1/4 W, 5%
R6448	321-0130-00			221 Ω, 1/8 W, 1%
R6458	311-1263-00			1 kΩ, Var
R6463	315-0104-00			100 kΩ, 1/4 W, 5%
R6467	315-0153-00			15 kΩ, 1/4 W, 5%
R6468	315-0622-00			6.2 kΩ, 1/4 W, 5%
R6472	315-0203-00			20 kΩ, 1/4 W, 5%
R6474	315-0222-00			2.2 kΩ, 1/4 W, 5%
R6504	321-0222-00			2 kΩ, 1/8 W, 1%
R6506	321-0319-00			20.5 kΩ, 1/8 W, 1%
R6508	321-0251-00			4.02 kΩ, 1/8 W, 1%
R6512	321-0258-00			4.75 kΩ, 1/8 W, 1%
R6514	321-0252-00			4.12 kΩ, 1/8 W, 1%
R6516	321-0219-00			1.87 kΩ, 1/8 W, 1%
R6518	321-0240-00			3.09 kΩ, 1/8 W, 1%
R6522	321-0182-00			768 Ω, 1/8 W, 1%
R6524	321-0246-00			3.57 kΩ, 1/8 W, 1%
R6526	321-0130-00			221 Ω, 1/8 W, 1%
R6528	321-0222-00			2 kΩ, 1/8 W, 1%
R6531	321-0319-00			20.5 kΩ, 1/8 W, 1%
R6533	321-0251-00			4.02 kΩ, 1/8 W, 1%
R6535	321-0258-00			4.75 kΩ, 1/8 W, 1%
R6537	321-0252-00			4.12 kΩ, 1/8 W, 1%
R6539	321-0219-00			1.87 kΩ, 1/8 W, 1%
R6542	321-0240-00			3.09 kΩ, 1/8 W, 1%
R6544	321-0182-00			768 Ω, 1/8 W, 1%
R6548	321-0246-00			3.57 kΩ, 1/8 W, 1%
R6552	321-0155-00			402 Ω, 1/8 W, 1%
R6555	321-0256-00			4.53 kΩ, 1/8 W, 1%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R6558	321-0287-00			9.53 kΩ, 1/8 W, 1%
R6564	315-0103-00			10 kΩ, 1/4 W, 5%
R6566	315-0223-00			22 kΩ, (nominal value) Selected
R6578	315-0271-00			270 Ω, 1/4 W, 5%
R6579	315-0182-00			1.8 kΩ, 1/4 W, 5%
R6582	315-0272-00			2.7 kΩ, 1/4 W, 5%
R6584	315-0362-00			3.6 kΩ, 1/4 W, 5%
R6586	315-0181-00			180 Ω, 1/4 W, 5%
R6612	315-0271-00			270 Ω, 1/4 W, 5%
R6614	315-0271-00			270 Ω, 1/4 W, 5%
R6634	321-0197-00			1.1 kΩ, 1/8 W, 1%
R6638	321-0212-00			1.58 kΩ, 1/8 W, 1%
R6642	321-0235-00			2.74 kΩ, 1/8 W, 1%
R6646	321-0258-00			4.75 kΩ, 1/8 W, 1%
R6648	321-0251-00			4.02 kΩ, 1/8 W, 1%
R6663	321-0306-00			15 kΩ, 1/8 W, 1%
R6668	315-0332-00			3.3 kΩ, 1/4 W, 5%
R6673	311-1265-00			2 kΩ, Var
R6677	321-0303-00			14 kΩ, 1/8 W, 1%
R6684	315-0272-00			2.7 kΩ, 1/4 W, 5%
R6689	321-0300-00			13 kΩ, 1/8 W, 1%
R6706	315-0393-00			39 kΩ, 1/4 W, 5%
R6724	321-0358-00			52.3 kΩ, 1/8 W, 1%
R6728	321-0262-00			5.23 kΩ, 1/8 W, 1%
R6734	321-0354-00			47.5 kΩ, 1/8 W, 1%
R6741	311-1263-00			1 kΩ, Var
R6742	315-0183-00			18 kΩ, 1/4 W, 5%
R6758	315-0102-00			1 kΩ, 1/4 W, 5%
R6782	315-0102-00			1 kΩ, (nominal value) Selected
R6791	321-0277-00			7.5 kΩ, 1/8 W, 1%
R6793	315-0102-00			1 kΩ, (nominal value) Selected
R6798	321-0230-00			2.43 kΩ, 1/8 W, 1%
R6833	311-1268-00	B010100	B019999	10 kΩ, Var
R6833	311-1266-00	B020000		2.5 kΩ, Var
R6836	311-1266-00			2.5 kΩ, Var
R6842	321-0271-00			6.49 kΩ, 1/8 W, 1%
R6844	321-0242-00			3.24 kΩ, 1/8 W, 1%
R6848	315-0102-00			1 kΩ, 1/4 W, 5%
R6859	315-0302-00			3 kΩ, 1/4 W, 5%
R6860	321-0260-00			4.99 kΩ, 1/8 W, 1%
R6864	308-0252-00			390 Ω, 3 W, WW, 5%
R6866	315-0221-00			220 Ω, 1/4 W, 5%
R6868	321-0222-00			2 kΩ, 1/8 W, 1%
R6875	315-0102-00			1 kΩ, 1/4 W, 5%
R6883	315-0100-00			10 Ω, 1/4 W, 5%
R6887	315-0302-00	XB070000		3 kΩ, 1/4 W, 5%
R6892	315-0102-00	B010100	B069999	1 kΩ, 1/4 W, 5%
R6892	315-0152-00	B070000		1.5 kΩ, 1/4 W, 5%
R6898	311-1260-00			250 Ω, Var
R6904	315-0100-00			10 Ω, 1/4 W, 5%
R6910	321-0341-00			34.8 kΩ, 1/8 W, 1%
R6912	321-0251-00	B010100	B069999	4.02 kΩ, 1/8 W, 1%
R6912	321-0257-00	B070000		4.64 kΩ, 1/8 W, 1%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R6920	321-0309-00			16.2 kΩ, 1/8 W, 1%
R6926	321-0357-00			51.1 kΩ, 1/8 W, 1%
R6938	311-1269-00			20 kΩ, Var
R6942	311-1263-00			1 kΩ, Var
R6944	321-0068-00			49.9 Ω, 1/8 W, 1%
R6956	315-0510-00			51 Ω, 1/4 W, 5%
R6977	311-1260-00			250 Ω, Var
R6983	321-0277-00			7.5 kΩ, 1/8 W, 1%
R6992	315-0100-00			10 Ω, 1/4 W, 5%
R6996	321-0277-00			7.5 kΩ, 1/8 W, 1%
R7001	315-0102-00			1 kΩ, 1/4 W, 5%
R7021	315-0472-00			4.7 kΩ, 1/4 W, 5%
R7023	321-0164-00			499 Ω, 1/8 W, 1%
R7025	315-0152-00			1.5 kΩ, 1/4 W, 5%
R7051	315-0472-00			4.7 kΩ, 1/4 W, 5%
R7121	321-0289-00			10 kΩ, 1/8 W, 1%
R7123	321-0030-00			20 Ω, 1/8 W, 1%
R7131	311-1007-00			20 Ω, Var
R7141	321-0039-00	B010100	B069999	24.9 Ω, 1/8 W, 1%
R7141	321-0053-00	B070000		34.8 Ω, 1/8 W, 1%
R7143	311-0635-00			1 kΩ, Var
R7181	315-0203-00			20 kΩ, 1/4 W, 5%
R7221	321-0256-00			4.53 kΩ, 1/8 W, 1%
R7240	315-0101-00			100 Ω, 1/4 W, 5%
R7241	321-0260-00			4.99 kΩ, 1/8 W, 1%
R7261	315-0472-00			4.7 kΩ, 1/4 W, 5%
R7331	315-0101-00			100 Ω, 1/4 W, 5%
R7333	315-0102-00			1 kΩ, 1/4 W, 5%
R7341	315-0302-00			3 kΩ, 1/4 W, 5%
R7351	315-0272-00			2.7 kΩ, 1/4 W, 5%
R7353	315-0152-00			1.5 kΩ, 1/4 W, 5%
R7355	315-0272-00			2.7 kΩ, 1/4 W, 5%
R7357	311-1263-00			1 kΩ, Var
R7361	311-0613-00			100 kΩ, Var
R7371	315-0101-00			100 Ω, 1/4 W, 5%
R7381	315-0101-00			100 Ω, 1/4 W, 5%
R7383	315-0474-00			470 kΩ, 1/4 W, 5%
R7385	315-0104-00			100 kΩ, 1/4 W, 5%
R7441	315-0102-00			1 kΩ, 1/4 W, 5%
R7443	321-0242-00			3.24 kΩ, 1/8 W, 1%
R7445	321-0309-00	B010100	B059999	16.2 kΩ, 1/8 W, 1%
R7445	321-0305-00	B060000		14.7 kΩ, 1/4 W, 1%
R7453	311-1267-00			5 kΩ, Var
R7461	321-0269-00			6.19 kΩ, 1/8 W, 1%
R7491	315-0222-00			2.2 kΩ, 1/4 W, 5%
R7492	315-0222-00			2.2 kΩ, 1/4 W, 5%
R7541	321-0373-00			75 kΩ, 1/8 W, 1%
R7542	315-0102-00			1 kΩ, 1/4 W, 5%
R7551	321-0241-00			3.16 kΩ, 1/8 W, 1%
R7553	321-0241-00			3.16 kΩ, 1/8 W, 1%
R7555	315-0153-00			15 kΩ, 1/4 W, 5%
R7561	311-1258-00			50 Ω, Var
R7563	321-0178-00			698 Ω, 1/8 W, 1%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R7571	315-0201-00			200 Ω, 1/4 W, 5%
R7581	321-0269-00			6.19 kΩ, 1/8 W, 1%
R7583	321-0126-00			200 Ω, 1/8 W, 1%
R7591	315-0222-00			2.2 kΩ, 1/4 W, 5%
R7593	315-0222-00			2.2 kΩ, 1/4 W, 5%
R7661	311-1261-00	B010100	B059999	500 Ω, Var
R7661	311-1263-00	B060000		1 kΩ, Var
R7685	321-0181-00			750 Ω, 1/8 W, 1%
R7691	321-0210-00			1.5 kΩ, 1/8 W, 1%
R7711	321-0164-00	B010100	B069999	499 Ω, (nominal value) Selected
R7711	321-0169-00	B070000		562 Ω, (nominal value) Selected
R7721	321-0105-00	B010100	B069999	121 Ω, (nominal value) Selected
R7721	321-0101-00	B070000		110 Ω, (nominal value) Selected
R7723	321-0172-00			604 Ω, 1/8 W, 1%
R7725	321-0097-00			100 Ω, 1/8 W, 1%
R7727	321-0260-00			4.99 kΩ, 1/8 W, 1%
R7729	321-0260-00			4.99 kΩ, 1/8 W, 1%
R7731	321-0164-00			499 Ω, 1/8 W, 1%
R7733	311-1263-00			1 kΩ, Var
R7735	311-1260-00			250 Ω, Var
R7751	321-0272-00			6.65 kΩ, 1/8 W, 1%
R7761	321-0260-00			4.99 kΩ, 1/8 W, 1%
R7763	315-0911-00			910 Ω, 1/4 W, 5%
R7781	315-0101-00			100 Ω, 1/4 W, 5%
R7841	321-0216-00			1.74 kΩ, 1/8 W, 1%
R7843	321-0189-00			909 Ω, 1/8 W, 1%
R7851	321-0222-00			2 kΩ, 1/8 W, 1%
R7853	308-0252-00			390 Ω, 3 W, WW, 5%
R7891	315-0302-00			3 kΩ, 1/4 W, 5%
R7893	315-0470-00			47 Ω, 1/4 W, 5%
R7901	315-0681-00			680 Ω, 1/4 W, 5%
R7911	315-0242-00			2.4 kΩ, 1/4 W, 5%
R7912	315-0221-00			220 Ω, 1/4 W, 5%
R7913	321-0210-00			1.5 kΩ, 1/8 W, 1%
R7915	321-0210-00			1.5 kΩ, 1/8 W, 1%
R7921	308-0252-00			390 Ω, 3 W, WW, 5%
R7923	321-0114-00	B010100	B019999	150 Ω, 1/8 W, 1%
R7923	321-0114-07	B020000		150 Ω, 1/8 W, 1/10%
R7931	321-0114-00	B010100	B019999	150 Ω, 1/8 W, 1%
R7931	321-0114-07	B020000		150 Ω, 1/8 W, 1/10%
R7933	321-0114-00	B010100	B019999	150 Ω, 1/8 W, 1%
R7933	321-0114-07	B020000		150 Ω, 1/8 W, 1/10%
R7935	321-0114-00	B010100	B019999	150 Ω, 1/8 W, 1%
R7935	321-0114-07	B020000		150 Ω, 1/8 w, 1/10%
R7941	321-0114-00	B010100	B019999	150 Ω, 1/8 W, 1%
R7941	321-0114-07	B020000		150 Ω, 1/8 W, 1/10%
R7943	321-0114-00	B010100	B019999	150 Ω, 1/8 W, 1%
R7943	321-0114-07	B020000		150 Ω, 1/8 W, 1/10%
R7951	315-0222-00			2.2 kΩ, 1/4 W, 5%
R7953	301-0821-00			820 Ω, 1/2 W, 5%
R7955	321-0085-00			75 Ω, 1/8 W, 1%
R7961	321-0105-00			121 Ω, (nominal value) Selected
R7963	321-0097-00			100 Ω, 1/8 W, 1%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R7971	315-0302-00			3 kΩ, 1/4 W, 5%
R7973	321-0068-00			49.9 Ω, 1/8 W, 1%
R7981	321-0239-00			3.01 kΩ, 1/8 W, 1%
R7983	321-0068-00			49.9 Ω, 1/8 W, 1%
R7991	315-0202-00			2 kΩ, 1/4 W, 5%
R7993	315-0470-00			47 Ω, 1/4 W, 5%
R7995	311-1258-00			50 Ω, Var
R8012	315-0102-00			1 kΩ, 1/4 W, 5%
R8015	315-0103-00			10 kΩ, 1/4 W, 5%
R8018	315-0470-00	B010100	B069999	47 Ω, 1/4 W, 5%
R8018	315-0201-00	B070000		200 Ω, 1/4 W, 5%
R8020	315-0471-00			470 Ω, 1/4 W, 5%
R8030	311-0978-00			250 Ω, Var
R8035	315-0562-00			5.6 kΩ, 1/4 W, 5%
R8040	315-0182-00			1.8 kΩ, 1/4 W, 5%
R8050	315-0270-00			27 Ω, 1/4 W, 5%
R8058	315-0472-00			4.7 kΩ, 1/4 W, 5%
R8060	311-1267-00			5 kΩ, Var
R8068	315-0203-00			20 kΩ, 1/4 W, 5%
R8070	315-0272-00			2.7 kΩ, 1/4 W, 5%
R8078	315-0272-00	B010100	B059999	2.7 kΩ, 1/4 W, 5%
R8078	315-0112-00	B060000		1.1 kΩ, 1/4 W, 5%
R8125	315-0103-00			10 kΩ, 1/4 W, 5%
R8128	315-0103-00			10 kΩ, 1/4 W, 5%
R8130	315-0471-00			470 Ω, 1/4 W, 5%
R8138	315-0512-00			5.1 kΩ, 1/4 W, 5%
R8150	315-0153-00			15 kΩ, 1/4 W, 5%
R8155	315-0470-00			47 Ω, 1/4 W, 5%
R8165	315-0153-00			15 kΩ, 1/4 W, 5%
R8170	315-0203-00			20 kΩ, 1/4 W, 5%
R8172	315-0512-00			5.1 kΩ, 1/4 W, 5%
R8185	315-0104-00			100 kΩ, 1/4 W, 5%
R8186	321-0172-00			604 Ω, 1/8 W, 5%
R8188	321-0184-00			806 Ω, 1/8 W, 1%
R8189	321-0222-00			2 kΩ, 1/8 W, 1%
R8190	321-0323-00			22.6 kΩ, 1/8 W, 1%
R8210	315-0752-00			7.5 kΩ, 1/4 W, 5%
R8215	315-0622-00			6.2 kΩ, 1/4 W, 5%
R8240	315-0102-00			1 kΩ, 1/4 W, 5%
R8245	315-0752-00			7.5 kΩ, 1/4 W, 5%
R8260	315-0272-00	B010100	B059999	2.7 kΩ, 1/4 W, 5%
R8260	315-0112-00	B060000		1.1 kΩ, 1/4 W, 5%
R8275	321-0193-00			1 kΩ, 1/8 W, 1%
R8280	315-0752-00			7.5 kΩ, 1/4 W, 5%
R8310	315-0472-00			4.7 kΩ, 1/4 W, 5%
R8330	315-0242-00			2.4 kΩ, 1/4 W, 5%
R8333	315-0122-00			1.2 kΩ, 1/4 W, 5%
R8335	315-0471-00			470 Ω, 1/4 W, 5%
R8338	315-0302-00			3 kΩ, 1/4 W, 5%
R8370	315-0242-00			2.4 kΩ, 1/4 W, 5%
R8372	315-0100-00			10 Ω, 1/4 W, 5%
R8380	311-1268-00			10 kΩ, Var
R8415	315-0272-00			2.7 kΩ, 1/4 W, 5%
R8440	315-0103-00			10 kΩ, 1/4 W, 5%
R8450	315-0202-00			2 kΩ, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R8472	315-0102-00			1 kΩ, 1/4 W, 5%
R8475	315-0302-00			3 kΩ, 1/4 W, 5%
R8494	321-0193-00			1 kΩ, 1/8 W, 1%
R8518	315-0100-00			10 Ω, 1/4 W, 5%
R8538	321-0293-00			11 kΩ, 1/8 W, 1%
R8540	315-0302-00			3 kΩ, 1/4 W, 5%
R8550	315-0512-00			5.1 kΩ, 1/4 W, 5%
R8552	315-0512-00			5.1 kΩ, 1/4 W, 5%
R8555	315-0101-00			100 Ω, 1/4 W, 5%
R8565	315-0622-00			6.2 kΩ, 1/4 W, 5%
R8568	315-0101-00			100 Ω, 1/4 W, 5%
R8570	315-0102-00			1 kΩ, 1/4 W, 5%
R8595	321-0193-00			1 kΩ, 1/8 W, 1%
R8612	315-0102-00			1 kΩ, 1/4 W, 5%
R8615	315-0101-00			100 Ω, 1/4 W, 5%
R8618	321-0323-00			22.6 kΩ, 1/8 W, 1%
R8630	311-1268-00			10 kΩ, Var
R8632	321-0306-00			15 kΩ, 1/8 W, 1%
R8650	315-0101-00			100 Ω, 1/4 W, 5%
R8652	315-0102-00			1 kΩ, 1/4 W, 5%
R8654	315-0302-00			3 kΩ, 1/4 W, 5%
R8655	321-0154-00			392 Ω, 1/8 W, 1%
R8658	321-0154-00			392 Ω, 1/8 W, 1%
R8668	315-0101-00			100 Ω, 1/4 W, 5%
R8669	315-0101-00			100 Ω, 1/4 W, 5%
R8670	315-0101-00			100 Ω, 1/4 W, 5%
R8710	321-0293-00			11 kΩ, 1/8 W, 1%
R8715	315-0202-00			2 kΩ, 1/4 W, 5%
R8720	321-0366-00			63.4 kΩ, 1/8 W, 1%
R8730	311-1267-00			5 kΩ, Var
R8740	321-0193-00			1 kΩ, 1/8 W, 1%
R8745	321-0272-07			6.65 kΩ, 1/8 W, 1/10%
R8750	311-1259-00			100 Ω, Var
R8752	321-0829-02			202 Ω, 1/8 W, 1/2%
R8755	315-0202-00			2 kΩ, 1/4 W, 5%
R8760	315-0392-00			3.9 kΩ, 1/4 W, 5%
R8765	321-0217-03			1.78 kΩ, 1/8 W, 1/4%
R8770	315-0181-00			180 Ω, 1/4 W, 5%
R8772	315-0181-00			180 Ω, 1/4 W, 5%
R8775	321-0272-07			6.65 kΩ, 1/8 W, 1/10%
R8814	321-0323-00			22.6 kΩ, 1/8 W, 1%
R8830	311-1269-00			20 kΩ, Var
R8835	311-1268-00			10 kΩ, Var
R8840	315-0512-00			5.1 kΩ, 1/4 W, 5%
R8842	321-0812-07			455 Ω, 1/8 W, 1/10%
R8844	321-0812-07			455 Ω, 1/8 W, 1/10%
R8846	321-0829-02			202 Ω, 1/8 W, 1/2%
R8848	321-0664-00			1.56 kΩ, 1/8 W, 1/2%
R8870	315-0202-00			2 kΩ, 1/4 W, 5%
R8872	321-0812-07			455 Ω, 1/8 W, 1/10%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R8874	321-0812-07			455 Ω, 1/8 W, 1/10%
R8876	321-0816-07			5 kΩ, 1/8 W, 1/10%
R8895	315-0470-00			47 Ω, 1/4 W, 5%
R8910	321-0289-00			10 kΩ, 1/8 W, 1%
R8918	315-0101-00			100 Ω, 1/4 W, 5%
R8930	311-1267-00			5 kΩ, Var
R8940	315-0470-00			47 Ω, 1/4 W, 5%
R8943	315-0104-00			100 kΩ, 1/4 W, 5%
R8946	315-0470-00			47 Ω, 1/4 W, 5%
R8958	315-0102-00			1 kΩ, 1/4 W, 5%
R8960	311-1259-00			100 Ω, Var
R8970	321-0816-07			5 kΩ, 1/8 W, 1/10%
R8974	321-0915-07			1.29 kΩ, 1/8 W, 1/10%
R8976	321-0915-07			1.29 kΩ, 1/8 W, 1/10%
R8990	315-0470-00			47 Ω, 1/4 W, 5%
R9001	321-0306-00	B010100	B069999X	15 kΩ, 1/8 W, 1%
R9002	321-0306-00			15 kΩ, 1/8 W, 1%
R9022	315-0153-00	XB070000		15 kΩ, 1/4 W, 5%
R9080	315-0102-00	XB070000		1 kΩ, 1/4 W, 5%
R9082	315-0153-00	XB070000		15 kΩ, 1/4 W, 5%
R9205	311-1182-00			1.5 kΩ, Var
R9209	311-0326-00			10 kΩ, Var
R9210	311-0585-00			15 kΩ, Var
R9212	321-0085-00			75 Ω, 1/8 W, 1%
R9215	311-0310-00			5 kΩ, Var
R9223	311-0103-00			10 kΩ, 1/4 W, 5%
R9225	311-1095-00			10 kΩ, Var
R9230	321-0267-00			5.9 kΩ, 1/8 W, 1%
R9231	321-0295-00			11.5 kΩ, 1/8 W, 1%
R9232	321-0287-00			9.53 kΩ, 1/8 W, 1%
R9233	321-0281-00			8.25 kΩ, 1/8 W, 1%
R9234	321-0272-00			6.65 kΩ, 1/8 W, 1%
R9235	321-0264-00			5.49 kΩ, 1/8 W, 1%
R9236	321-0257-00			4.64 kΩ, 1/8 W, 1%
R9237	321-0249-00			3.83 kΩ, 1/8 W, 1%
R9238	321-0244-00			3.4 kΩ, 1/8 W, 1%
R9239	321-0241-00			3.16 kΩ, 1/8 W, 1%
R9280	311-0068-00			500 kΩ, Var
R9291	321-0170-00			576 Ω, 1/8 W, 1%
R9292	321-0180-00			732 Ω, 1/8 W, 1%
R9293	321-0190-00			931 Ω, 1/8 W, 1%
R9294	321-0202-00			1.24 kΩ, 1/8 W, 1%
R9295	321-0216-00			1.74 kΩ, 1/8 W, 1%
R9296	321-0233-00			2.61 kΩ, 1/8 W, 1%
R9297	321-0254-00			4.32 kΩ, 1/8 W, 1%
R9298	321-0283-00			8.66 kΩ, 1/8 W, 1%
R9299	321-0329-00			26.1 kΩ, 1/8 W, 1%
R9800	315-0101-00			100 Ω, 1/4 W, 5%
R9801	311-1268-00			10 kΩ, Var
R9802	315-0101-00			100 Ω, 1/4 W, 5%
R9803	308-0344-00			18.2 Ω, 3 W, WW, 1%
R9804	308-0463-00			0.3 Ω, 3 W, WW, 1%
R9806	315-0431-00			430 Ω, 1/4 W, 5%

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
RESISTORS (cont)				
R9808	321-0197-00			1.1 kΩ, 1/8 W, 1%
R9810	321-0189-00			909 Ω, 1/8 W, 1%
R9812	315-0752-00			7.5 kΩ, 1/4 W, 5%
R9814	315-0101-00			100 Ω, 1/4 W, 5%
R9816	315-0471-00			470 Ω, 1/4 W, 5%
R9818	315-0751-00			750 Ω, 1/4 W, 5%
R9830	315-0101-00			100 Ω, 1/4 W, 5%
R9831	311-1268-00			10 kΩ, Var
R9832	308-0245-00			0.6 Ω, 2 W, WW, 5%
R9834	315-0101-00			100 Ω, 1/4 W, 5%
R9836	315-0431-00			430 Ω, 1/4 W, 5%
R9838	321-0224-00			2.1 kΩ, 1/8 W, 1%
R9840	321-0189-00			909 Ω, 1/8 W, 1%
R9842	315-0472-00			4.7 kΩ, 1/4 W, 5%
R9844	315-0471-00			470 Ω, 1/4 W, 5%
R9846	315-0301-00			300 Ω, 1/4 W, 5%
R9848	315-0182-00			1.8 kΩ, 1/4 W, 5%
R9850	315-0152-00			1.5 kΩ, 1/4 W, 5%
R9851	311-1268-00			10 kΩ, Var
R9852	315-0431-00			430 Ω, 1/4 W, 5%
R9854	321-0172-00			604 Ω, 1/8 W, 1%
R9856	321-0189-00			909 Ω, 1/8 W, 1%
R9858	321-0173-00			619 Ω, 1/8 W, 1%
R9860	315-0471-00			470 Ω, 1/4 W, 5%
R9862	315-0301-00			300 Ω, 1/4 W, 5%
R9864	315-0472-00			4.7 kΩ, 1/4 W, 5%
R9866	315-0101-00			100 Ω, 1/4 W, 5%
R9868	315-0101-00			100 Ω, 1/4 W, 5%
R9870	315-0151-00	B010100	B059999	150 Ω, 1/4 W, 5%
R9870	315-0331-00	B060000		330 Ω, 1/4 W, 5%
R9872	315-0392-00			3.9 kΩ, 1/4 W, 5%
R9874	308-0245-00			0.6 Ω, 2 W, WW, 5%
SWITCHES				
S9000	260-0583-01			Slide, SYNC SOURCE
S9201	260-0276-00			Toggle, POWER
S9202[1]				
S9203[1]				
S9205	260-0731-00			Lever, UNITY GAIN/VAR
S9212	260-1249-00			Lever, REMOTE/LOCAL
S9213	260-1248-00			Lever, PROGRAM/PREVIEW/AUXILIARY
S9225	260-0731-00			Lever, NOISE
S9230	260-0621-00			Lever, PEDESTAL
S9235	260-1252-00			Rotary, NOISE LEVEL dB 5 position
S9240	260-1251-00			Rotary, NOISE LEVEL dB 10 position
S9250	260-0664-00			Lever, MULTIBURST AMPLITUDE
S9255	260-0731-00			Lever, LINEARITY SUBCARRIER
S9260	260-1250-00			Rotary, FULL FIELD SIG Mode
S9270	260-0621-00			Lever, LINEARITY Mode
S9285	260-0731-00			Lever, APL BOUNCE 10-90/VARIABLE
S9290	260-1088-00			Rotary, APL VARIABLE

[1]See Mechanical Parts List. Line Voltage Selector Body.

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
TRANSFORMER				
T9001	120-0737-00			Power
INTEGRATED CIRCUITS				
U21	156-0043-00			Quad 2-input positive nor gate, replaceable by SN7402N
U101	156-0114-00			Single 10 MHz divided by -2-&-6 ripple counter, replaceable by SN7492N
U201	156-0072-00			Single monostable multivibrator-one shot, replaceable by SN74121N
U301	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U761	155-0022-00			Monolithic, single switch
U861	155-0022-00			Monolithic, single switch
U1001	156-0035-00			Single 8-input positive nand gate, replaceable by SN7430N
U1031	156-0035-00			Single 8-input positive nand gate, replaceable by SN7430N
U1061	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U1091	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U1101	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U1131	156-0034-00			Dual 4-input positive nand gate, replaceable by SN7420N
U1161	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U1191	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U1201	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U1231	156-0035-00			Single 8-input positive nand gate, replaceable by SN7430N
U1261	156-0035-00			Single 8-input positive nand gate, replaceable by SN7430N
U1291	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U1301	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U1331	156-0034-00			Dual 4-input positive nand gate, replaceable by SN7420N
U1361	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U1391	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U1431	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U1461	156-0047-00			Triple 3-input positive nand gate, replaceable by SN7410N
U2001	156-0078-00			Single 1-out-of-16-line decoder/demultiplexer, replaceable by SN74154N
U2061	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2081	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2261	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
INTEGRATED CIRCUITS (cont)				
U2281	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2401	156-0078-00			Single 1-out-of-16-line decoder/demultiplexer, replaceable by SN74154N
U2461	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2481	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2661	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2681	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2721	156-0037-00			Dual 2 wide 2-input pos and-or-invert gate, replaceable by SN7451N
U2741	156-0035-00			Single 8-input positive nand gate, replaceable by SN7430N
U2761	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2781	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2811	156-0072-00			Single monostable multivibrator-one shot, replaceable by SN74121N
U2831	156-0035-00			Single 8-input positive nand gate, replaceable by SN7430N
U2861	156-0035-00			Single 8-input positive nand gate, replaceable by SN7430N
U2881	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2911	156-0057-00			Quad 2-input positive nand gate, replaceable by SN7401N
U2931	156-0058-00			Hex. inverter, replaceable by SN7404N
U2961	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U2981	156-0057-00			Quad 2-input positive nand gate, replaceable by SN7401N
U3100	156-0048-00			Five NPN transistor array, replaceable by CA3046
U3585	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U3735	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U3755	156-0058-00			Hex. inverter, replaceable by SN7404N
U3775	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U3835	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U3855	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U3875	156-0043-00			Quad 2-input positive nor gate, replaceable by SN7402N
U4151	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U4171	156-0043-00			Quad 2-input positive nor gate, repalceable by SN7402N
U4271	156-0041-00			Dual 15 MHz D-type pos-edge-trig flip-flop, replaceable by SN7474N
U4351	156-0078-00			Single 1-out-of-16-line decoder/multiplexer, replaceable by SN74154N

ELECTRICAL PARTS LIST (cont)

Ckt. No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Description
INTEGRATED CIRCUITS (cont)				
U4471	156-0032-00			Single 10 MHz 1-&-3-bit binary ripple counter, replaceable by SN7493N
U4551	156-0043-00			Quad 2-input positive nor gate, replaceable by SN7402N
U4571	156-0058-00			Hex. inverter, replaceable by SN7404N
U4621	156-0043-00			Quad 2-input positive nor gate, replaceable by SN7402N
U4641	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U4681	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U4721	156-0058-00			Hex. inverter, replaceable by SN7404N
U4741	156-0043-00			Quad 2-input positive nor gate, replaceable by SN7402N
U4761	156-0047-00			Triple 3-input positive nand gate, replaceable by SN7410N
U4781	156-0058-00			Hex. inverter, replaceable by SN7404N
U4821	156-0035-00			Single 8-input, positive nand gate, replaceable by SN7430N
U4841	156-0043-00			Quad 2-input positive nor gate, replaceable by SN7402N
U4861	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U4881	156-0030-00			Quad 2-input positive nand gate, replaceable by SN7400N
U6170	156-0048-00			Five NPN transistor array, replaceable by CA3046
U7251	156-0057-00			Quad 2-input positive nand gate, replaceable by SN7401N
U7291	156-0067-00			Qperational amplifier, replaceable by µA741C
U8070	156-0043-00			Quad 2-input positive nor gate, replaceable by SN7402N
U8310	156-0092-00			Hex. inverter, replaceable by SN7405N
U8510	156-0030-00			Quad 2 input positve nand gate, replaceable by SN7400N
U8890	156-0130-00			Balanced modulator/demodulator, replaceable by MC1496
CRYSTAL				
Y5639	158-0069-00			3.579545 MHz

SECTION 7

DIAGRAMS AND CIRCUIT BOARD ILLUSTRATIONS

Symbols and Reference Designators

Electrical components shown on the diagrams are in the following units unless noted otherwise:

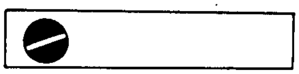
Capacitors = Values one or greater are in picofarads (pF).
Values less than one are in microfarads (μF).

Resistors = Ohms (Ω)

Symbols used on the diagrams are based on USA Standard Y32.2-1967.

Logic symbology is based on MIL-STD-806B in terms of positive logic. Logic symbols depict the logic function performed and may differ from the manufacturer's data.

The following special symbols are used on the diagrams:



External Screwdriver adjustment.



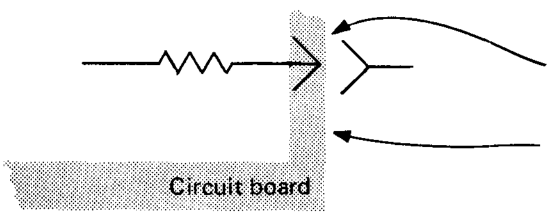
External control or connector.



Refer to diagram number indicated in diamond.



Refer to waveform number indicated in hexagon.



Connection made to circuit board with interconnecting pin.

Blue tint encloses components located on circuit board.

The following prefix letters are used as reference designators to identify components or assemblies on the diagrams.

A	Assembly, separable or repairable (circuit board, etc.)
AT	Attenuator, fixed or variable
B	Motor
BT	Battery
C	Capacitor, fixed or variable
CR	Diode, signal or rectifier
DL	Delay line
DS	Indicating device (lamp)
F	Fuse
FL	Filter
H	Heat dissipating device (heat sink, heat radiator, etc.)
HR	Heater
J	Connector, stationary portion
K	Relay
L	Inductor, fixed or variable
LR	Inductor/resistor combination
M	Meter
Q	Transistor or silicon-controlled rectifier
P	Connector, movable portion
R	Resistor, fixed or variable
RT	Thermistor
S	Switch
T	Transformer
TP	Test point
U	Assembly, inseparable or non-repairable (integrated circuit, etc.)
V	Electron tube
VR	Voltage regulator (zener diode, etc.)
Y	Crystal

VOLTAGE AND WAVEFORM CONDITIONS

Circuit voltages measured with a 20,000 Ω/volt VOM; all readings in volts. Voltages are measured with respect to chassis ground unless noted otherwise.

Waveforms shown are actual photographs taken with a Tektronix Oscilloscope Camera System. Each major division represents one cm. Test oscilloscope deflection factor and sweep rate conditions are noted on each waveform. DC coupling was used to obtain the DC levels that are recorded at the right side of each waveform. These DC levels are located with respect to the graticule rather than to the waveform. To indicate time relationship between signals, the test oscilloscope was triggered externally, where possible. The triggering source, except where noted, was the 147 COMPOSITE SYNC.

Voltages and Waveforms on the diagram (shown in blue) are not absolute and may vary between instruments because of differing component tolerances, internal calibration, etc.

The test oscilloscope used for obtaining the waveform photographs had the following minimum characteristics: Deflection factor, 1 mV/Cm (10 mV/Cm to 10 V/Cm with a 10X probe); frequency response, DC to 10 MHz; sweep rates, 0.05 μs/Cm to 5 ms/Cm.

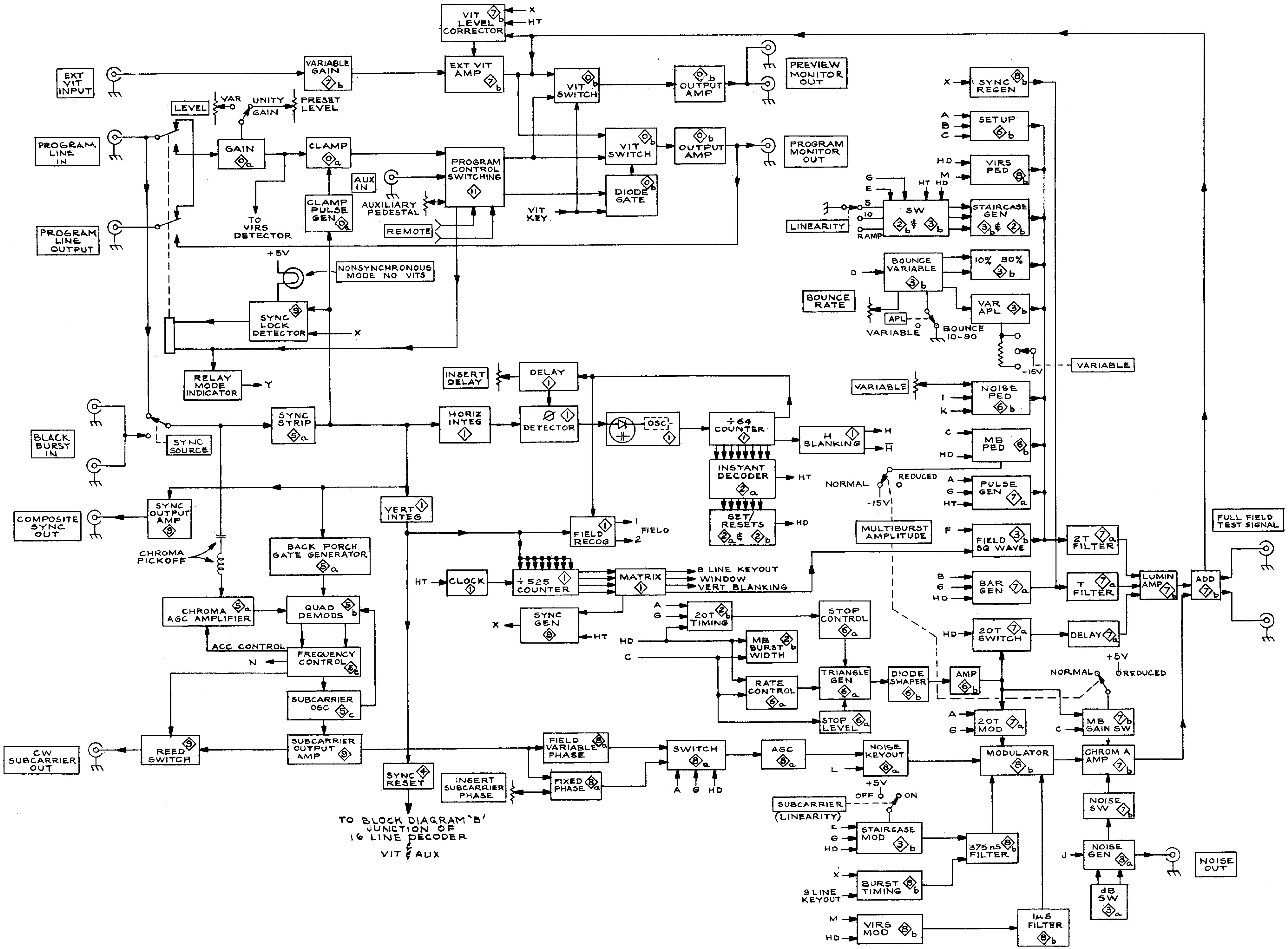
WARNING

"Coaxial shields and ground lugs" are not always at ground potential. Check the diagram before using such connections as a ground for the VOM or test oscilloscope probe.

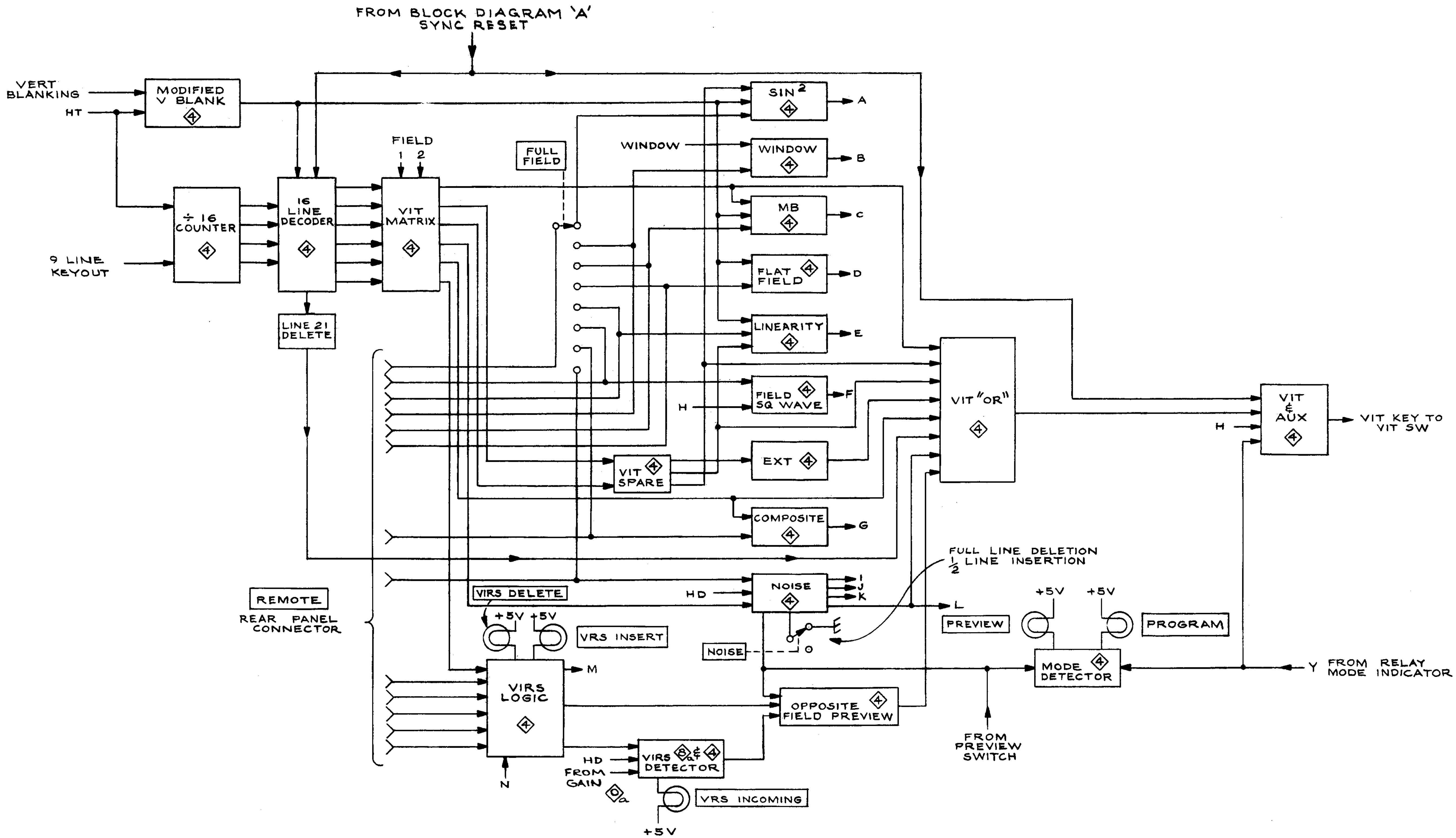
A Tektronix Type 140 NTSC TEST SIGNAL GENERATOR was used to provide an external 1 volt peak to peak composite video signal to the 147 PROGRAM LINE IN.

Unless noted otherwise on each diagram, the 147 switches were set at follows:

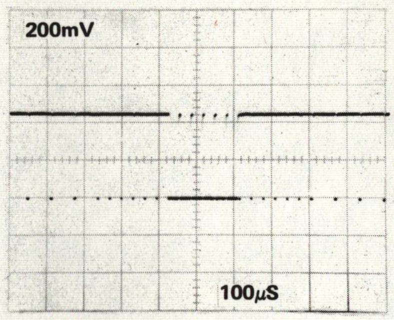
POWER	ON
PROGRAM CONTROL	
UNITY GAIN/VAR	UNITY GAIN
PROGRAM/PREVIEW/AUXILIARY	PROGRAM
LOCAL/REMOTE	LOCAL
NOISE AND PEDESTAL	
NOISE	DELETION (Full Line)
PEDESTAL	100 IRE
NOISE LEVEL dB	OFF, 0
MULTIBURST AMPLITUDE	NORMAL
LINEARITY	
SUBCARRIER	ON
Mode	5 STEPS
FULL FIELD SIG	
Mode	LINEARITY
APL	BOUNCE 10-90
VARIABLE	0



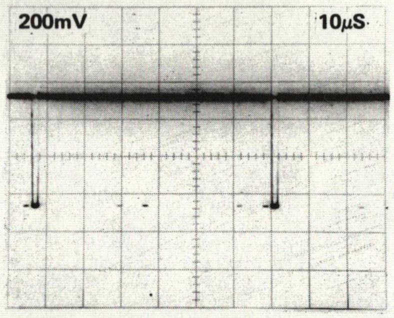
BLOCK DIAGRAM 'A' REV. JAN. 1974


FROM BLOCK DIAGRAM 'A'
SYNC RESET
VERT BLANKING
HT
MODIFIED V BLANK
÷ 16 COUNTER
9 LINE KEYOUT
16 LINE DECODER
LINE 21 DELETE
FIELD
1 2
VIT MATRIX
FULL FIELD
WINDOW
SIN²
A
WINDOW
B
MB
C
FLAT FIELD
D
LINEARITY
E
FIELD SQ WAVE
F
H
EXT
VIT SPARE
COMPOSITE
G
VIT "OR"
VIT & AUX
H
VIT KEY TO VIT SW
FULL LINE DELETION
½ LINE INSERTION
NOISE
HD
I
J
K
L
VIRS DELETE
+5V
+5V
VRS INSERT
REMOTE
REAR PANEL CONNECTOR
NOISE
VIRS LOGIC
M
N
OPPOSITE FIELD PREVIEW
VIRS DETECTOR
HD
FROM GAIN
VRS INCOMING
+5V
PREVIEW
PROGRAM
+5V
+5V
MODE DETECTOR
Y FROM RELAY MODE INDICATOR
FROM PREVIEW SWITCH

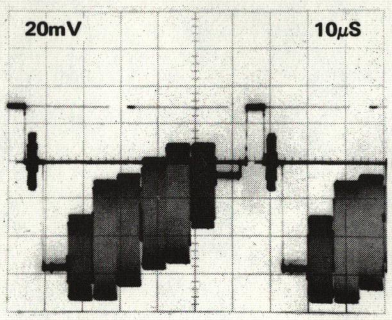
1



2



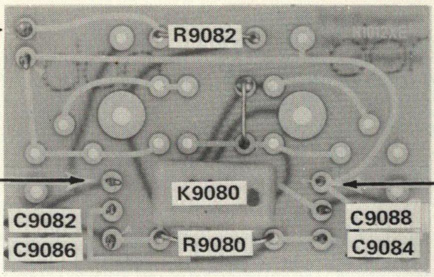
3



Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page except as follows:

1. Waveform ⟨1⟩ obtained by using delayed sweep.

P9082
1
2 red-yel on wht



P9080
1 grn-vio on wht
2 blk coax
3 shield for 2

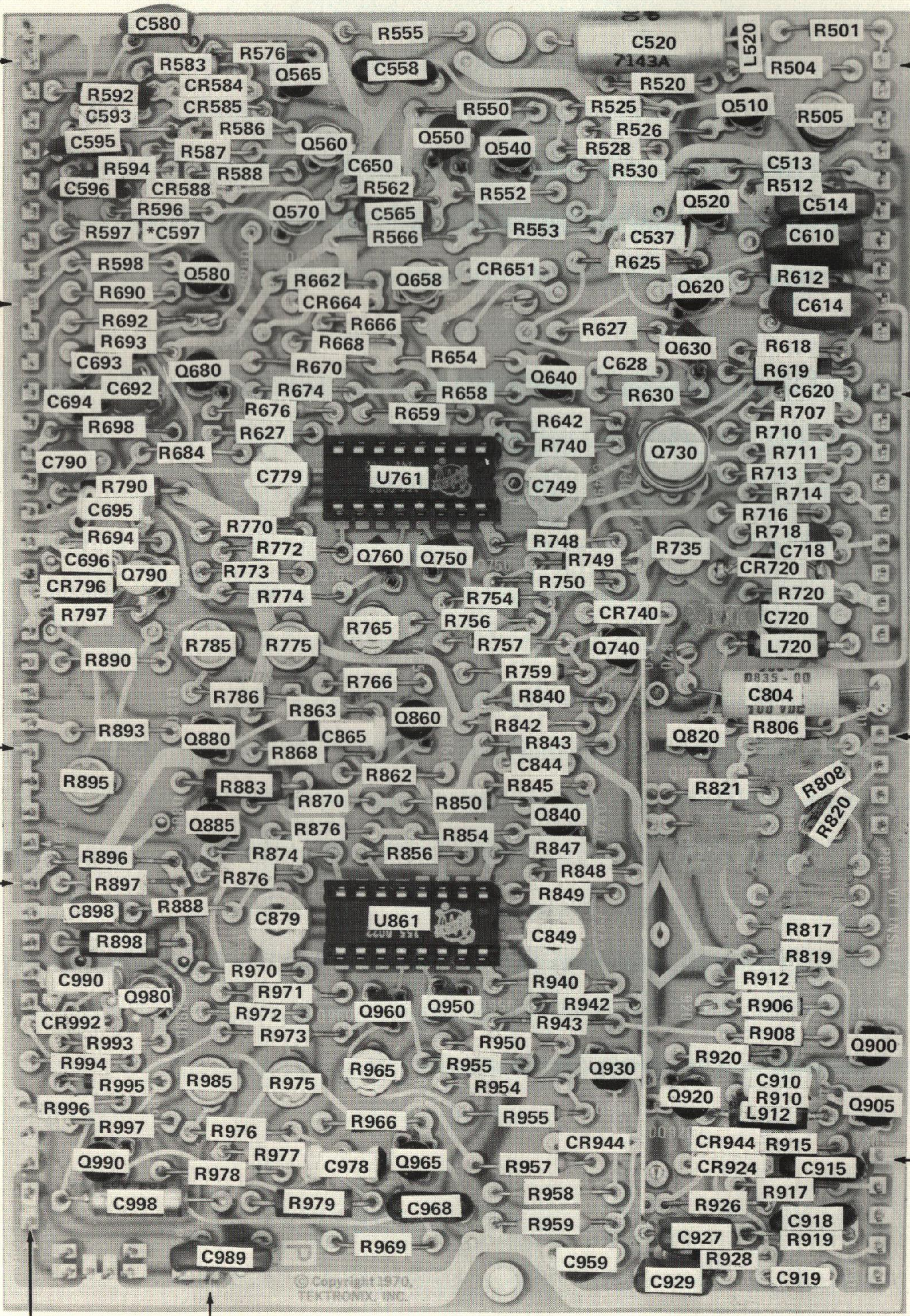
P9084
1 grn-gry on wht
2 blk coax
3 shield for 2

P591
1
2 blu-gry on wht
3 blk-gry on wht coax
4 blk
5 yel-blu on wht
6 blu on wht
7 blk coax
8 shield for 7
9 blk

P691
1 blk
2 shield for 3
3 blk-gry on wht coax
4 shield for 5
5 vio on wht coax
6 shield for 7
7 blk coax
8 blk-blu on wht
9 grn-vio on wht
10 yel-vio on wht

P791
1 blu-gry on wht
2 blk-gry on wht coax
3 blk on wht coax
4 yel on wht coax

P891
1 blk on red
2 grn on wht coax
3 shield for 2
4 shield for 5
5 yel on wht coax



P501
1 gry on wht
2
3 vio on wht coax
4 shield for 3
5 blu on wht coax
6 shield for 5
7 brn on red
8 blk on red
9 blk on vio
10

P701
1 blk
2
3 blk-orn on wht
4
5 blk-yel on wht
6 shield for 7
7 blk-grn on wht coax
8 blk-blu on wht
9

P801
1 orn on wht
2
3 blk-red on wht
4 blk on wht

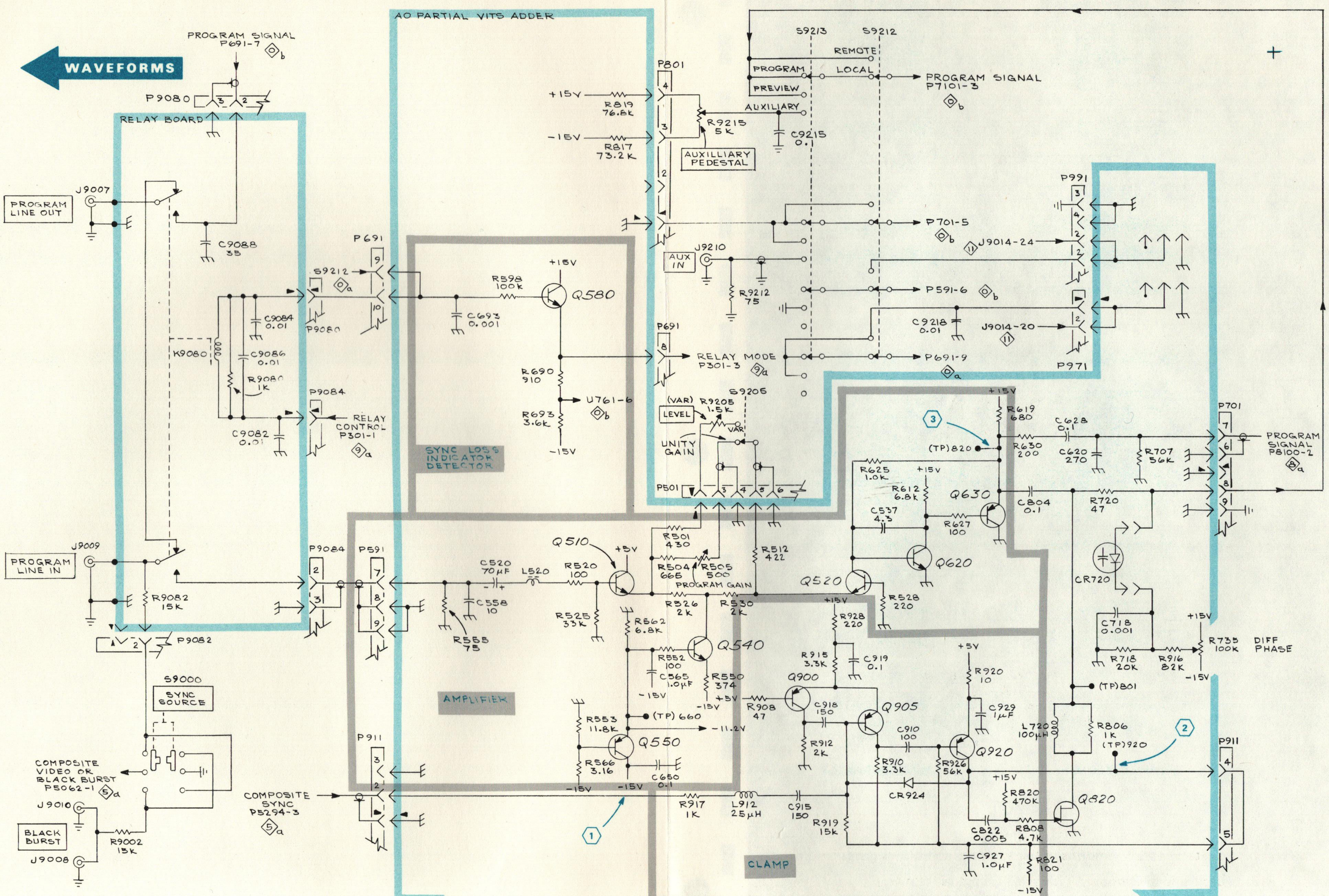
P911
1
2 wht coax
3 shield for 3
4 blk
5 blk

*Added SN B080000

P991
1 red on wht
2 red on wht
3
4 blk

P971
1 brn on wht
2 brn on wht

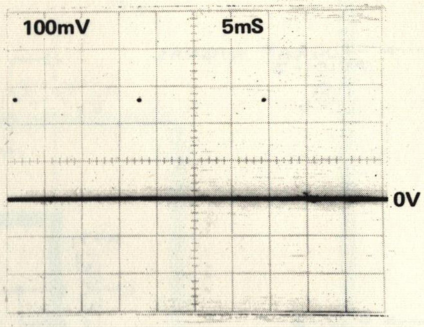
PROGRAM LINE AMPLIFIER



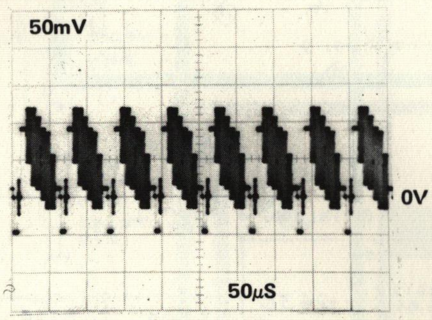
147/R147

PROGRAM LINE AMPLIFIER
SN B070000-UP

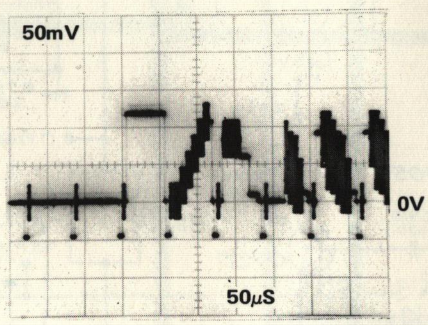
1



2



3



Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page except as follows:

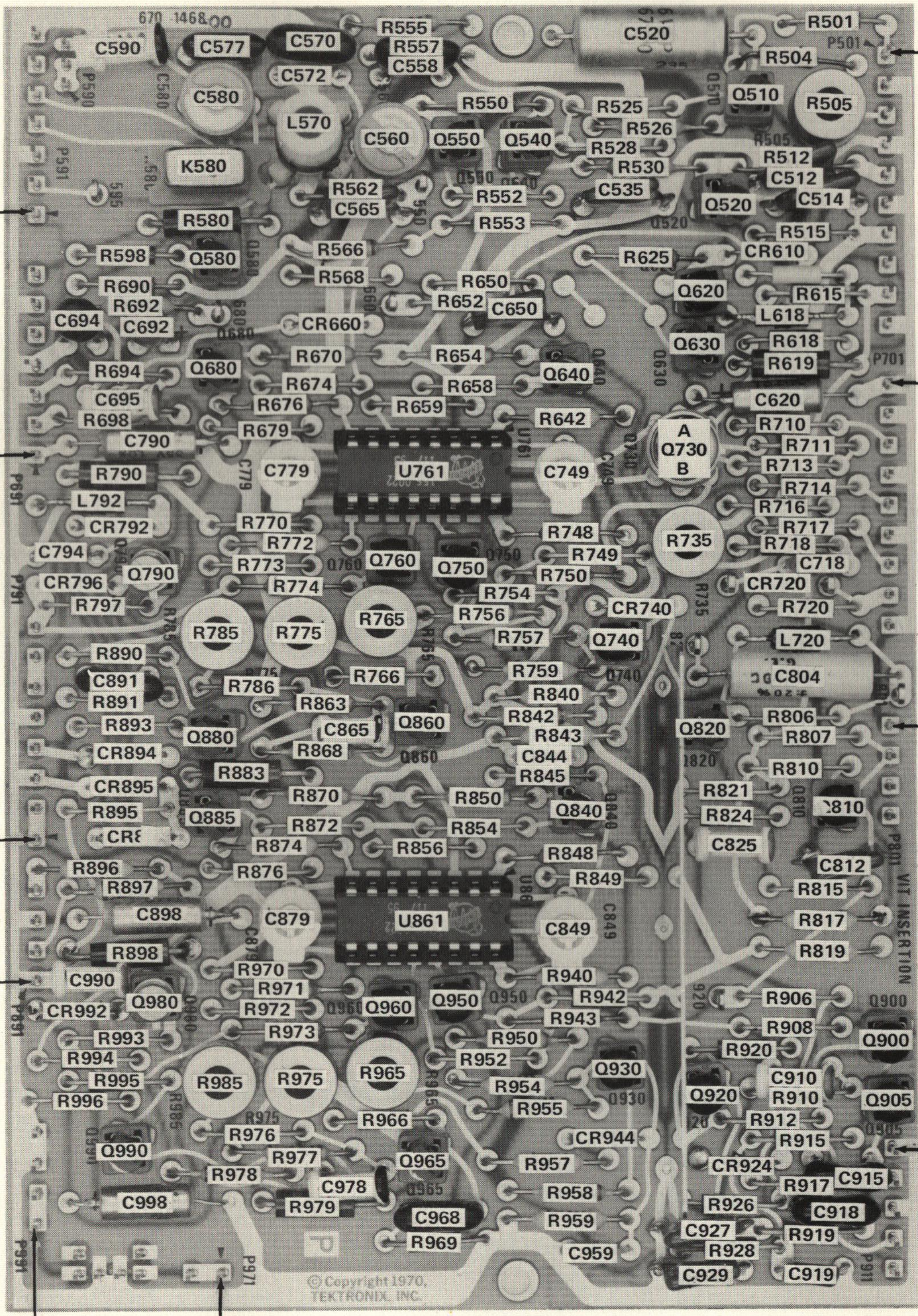
1. Waveforms ⟨2⟩ and ⟨3⟩ obtained using delayed sweep.

P591
1
2 blk coax
3 shield for 2
4 grn-blu on wht
5 blk coax
6 shield for 5

P691
1 shield for 2
2 vio on blk coax
3
4
5 blk-grn on wht
6
7 yel-vio on wht

P791
1 blk on wht coax
2 yel on wht coax
3 shield for 1
4 brn-gry on wht
5 shield for 2
6 yel-blu on wht
7 yel-blu on wht
8

P891
1 shield for 2
2 grn on wht coax
3 shield for 4
4 yel on wht coax



P501
1 gry on wht
2
3 vio on wht coax
4 shield for 3
5 blu on wht coax
6 shield for 5
7 brn on red
8 blk on red
9 blk on vio
10

P701
1 blk
2
3 blk-orn on wht
4
5 blk-yel on wht
6 shield for 7
7 blk-grn on wht coax
8 blk-blu on wht
9

P801
1
2 orn on wht
3 blk-red on wht
4 blk-brn on wht

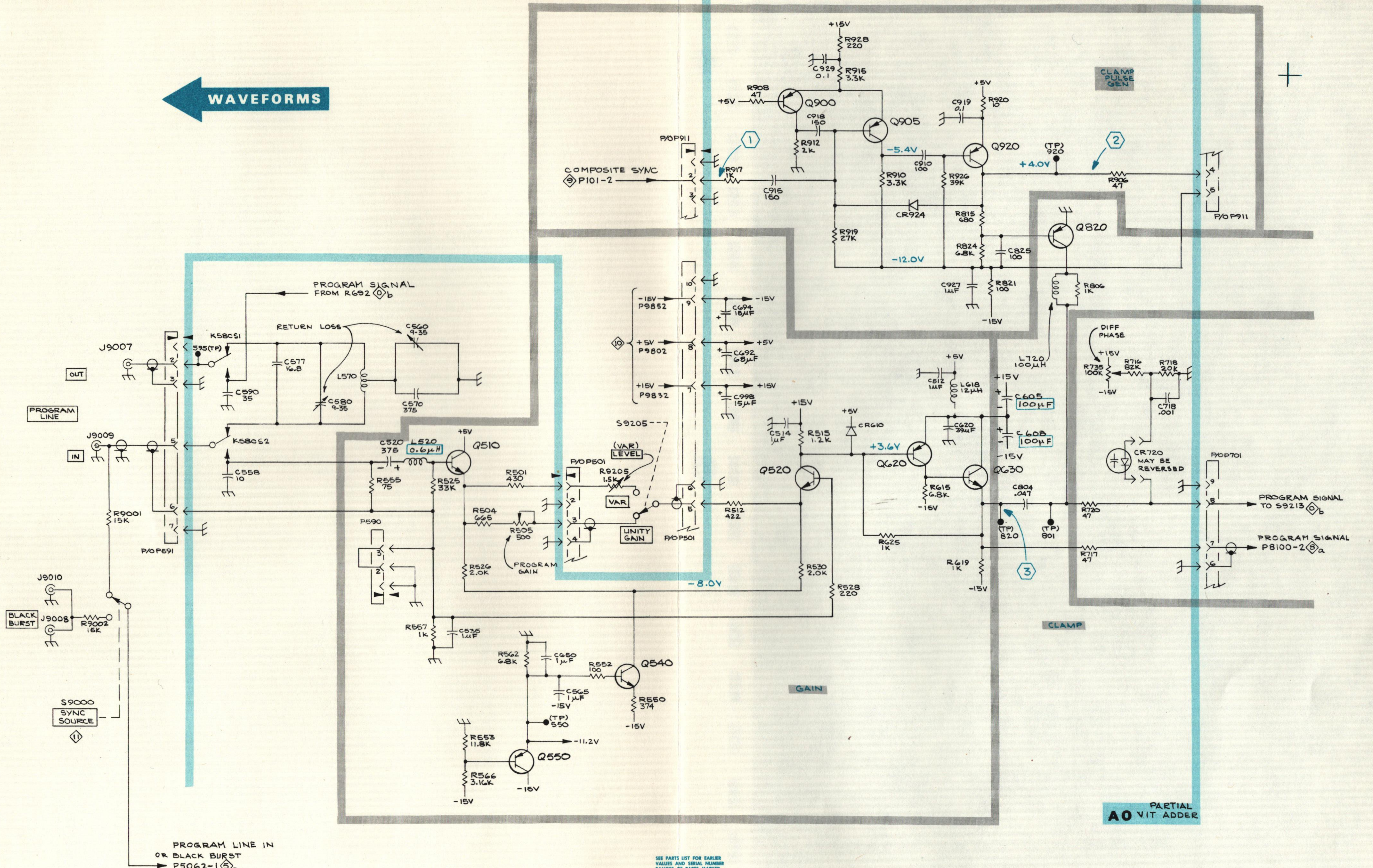
P911
1
2 red-blu on wht
3
4
5

P991
1 red on wht
2 red on wht
3 blk
4

P971
1 brn on wht
2 brn on wht

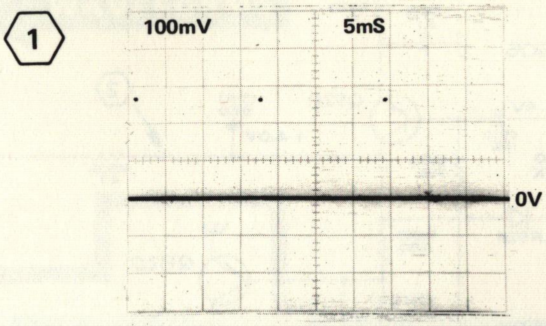
PROGRAM LINE AMPLIFIER

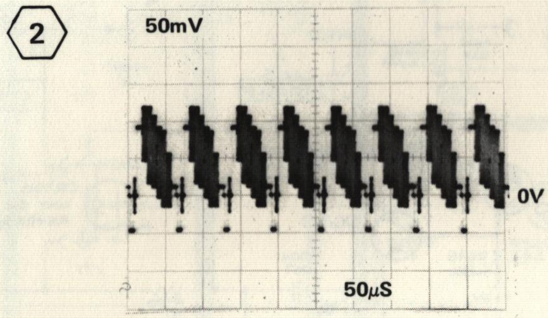
WAVEFORMS

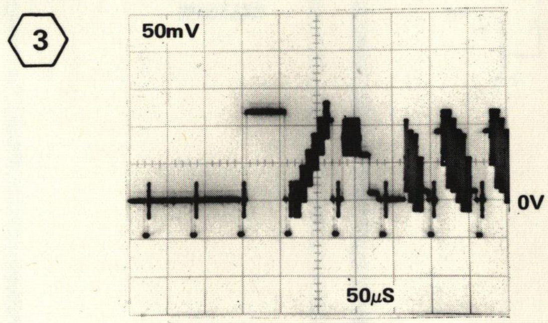


NOTE:
SEE PARTS LIST FOR SEMICONDUCTOR TYPES

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.







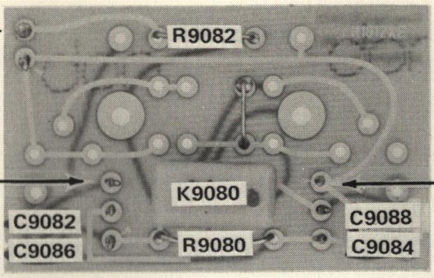
Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page except as follows:

1. Waveforms ⟨2⟩ and ⟨3⟩ obtained using delayed sweep.

P9082
1
2 red-yel on wht

P9080
1 grn-vio on wht
2 blk coax
3 shield for 2

P9084
1 grn-gry on wht
2 blk coax
3 shield for 2



P591
1
2 blu-gry on wht
3 blk-gry on wht coax
4 blk
5 yel-blu on wht
6 blu on wht
7 blk coax
8 shield for 7
9 blk

P501
1 gry on wht
2
3 vio on wht coax
4 shield for 3
5 blu on wht coax
6 shield for 5
7 brn on red
8 blk on red
9 blk on vio
10

P691
1 blk
2 shield for 3
3 blk-gry on wht coax
4 shield for 5
5 vio on wht coax
6 shield for 7
7 blk coax
8 blk-blu on wht
9 grn-vio on wht
10 yel-vio on wht

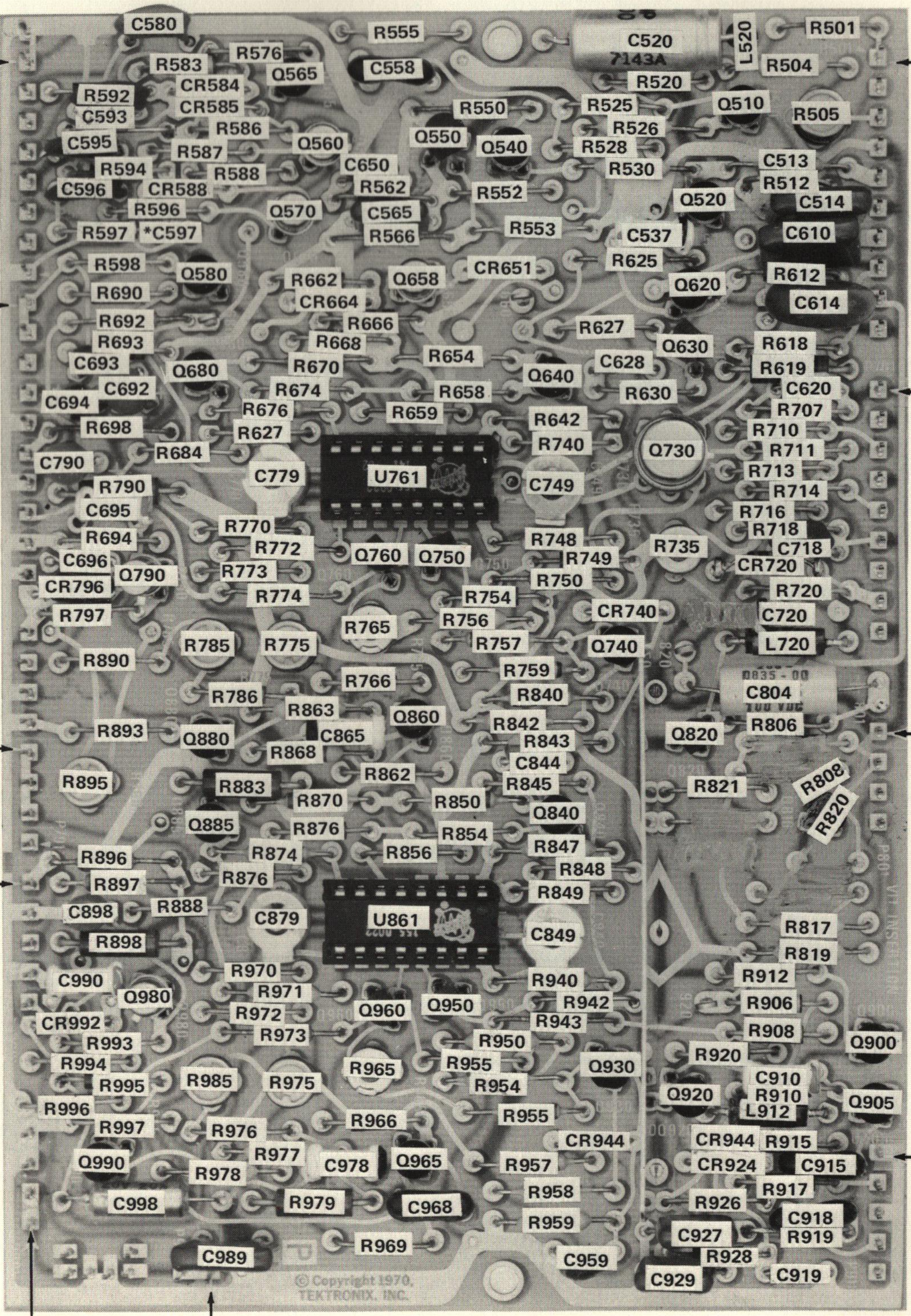
P701
1 blk
2
3 blk-orn on wht
4
5 blk-yel on wht
6 shield for 7
7 blk-grn on wht coax
8 blk-blu on wht
9

P791
1 blu-gry on wht
2 blk-gry on wht coax
3 blk on wht coax
4 yel on wht coax

P801
1 orn on wht
2
3 blk-red on wht
4 blk on wht

P891
1 blk on red
2 grn on wht coax
3 shield for 2
4 shield for 5
5 yel on wht coax

P911
1
2 wht coax
3 shield for 3
4 blk
5 blk



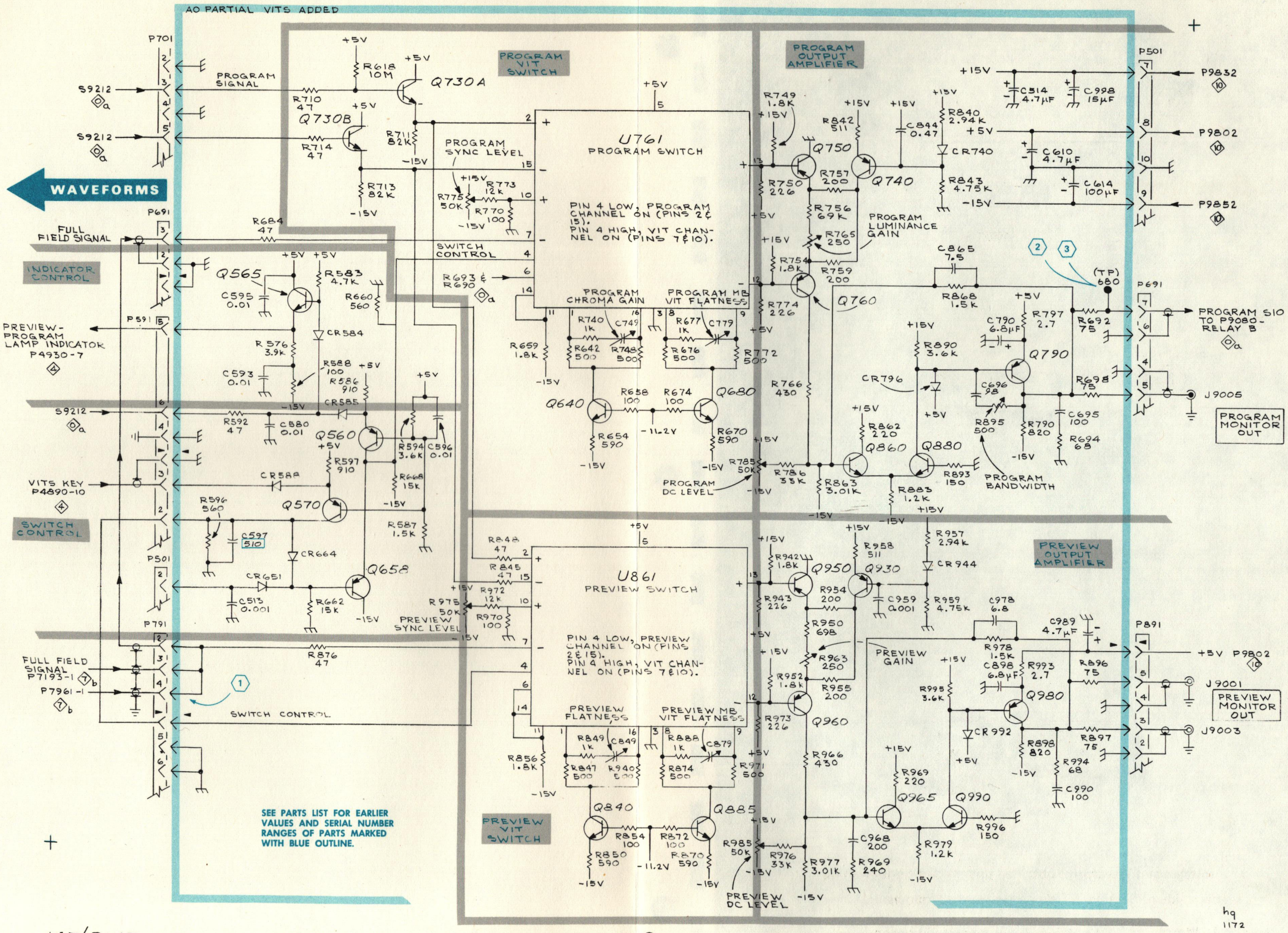
*Added SN B080000

P991
1 red on wht
2 red on wht
3
4 blk

P971
1 brn on wht
2 brn on wht

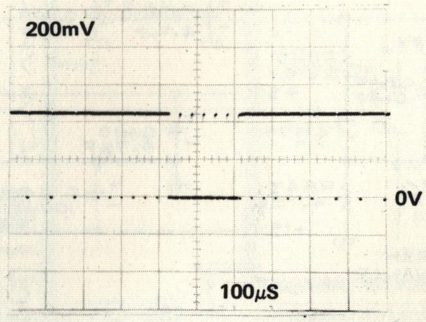
VIT INSERTION

Ⓐ

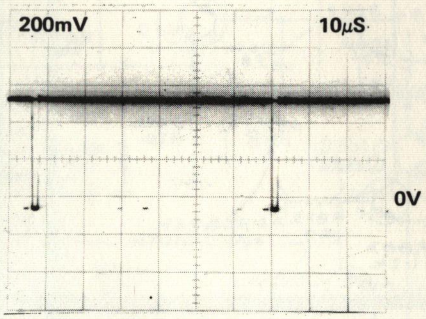


VIT INSERTER ⓪b
SN B070000-UP

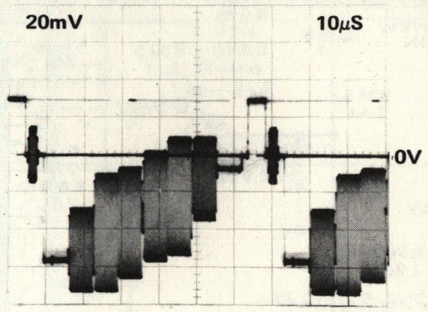
1



2



3



Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page except as follows:

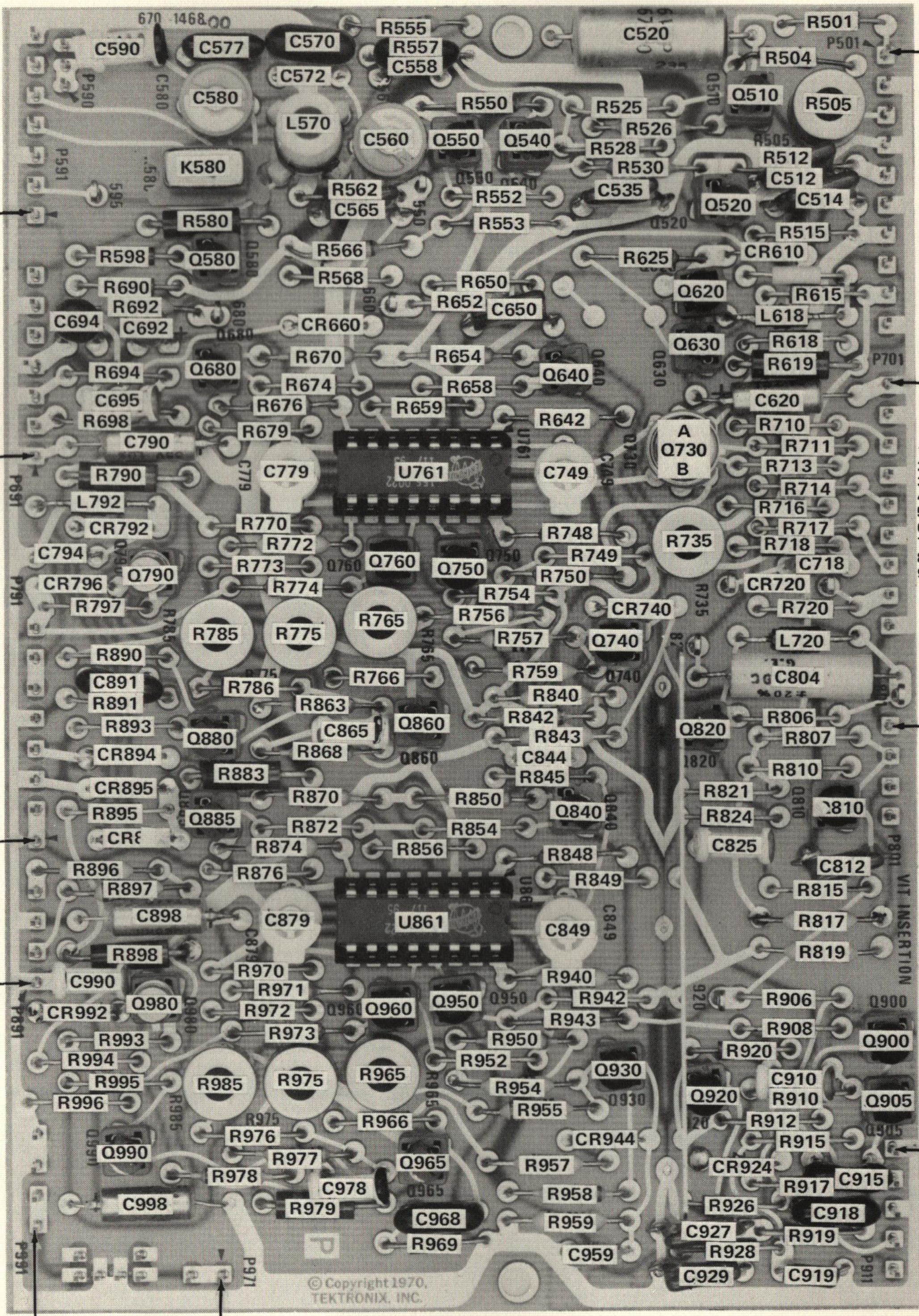
1. Waveform ⟨1⟩ obtained by using delayed sweep.

P591
1
2 blk coax
3 shield for 2
4 grn-blu on wht
5 blk coax
6 shield for 5

P691
1 shield for 2
2 vio on blk coax
3
4
5 blk-grn on wht
6
7 yel-vio on wht

P791
1 blk on wht coax
2 yel on wht coax
3 shield for 1
4 brn-gry on wht
5 shield for 2
6 yel-blu on wht
7 yel-blu on wht
8

P891
1 shield for 2
2 grn on wht coax
3 shield for 4
4 yel on wht coax



P501
1 gry on wht
2
3 vio on wht coax
4 shield for 3
5 blu on wht coax
6 shield for 5
7 brn on red
8 blk on red
9 blk on vio
10

P701
1 blk
2
3 blk-orn on wht
4
5 blk-yel on wht
6 shield for 7
7 blk-grn on wht co
8 blk-blu on wht
9

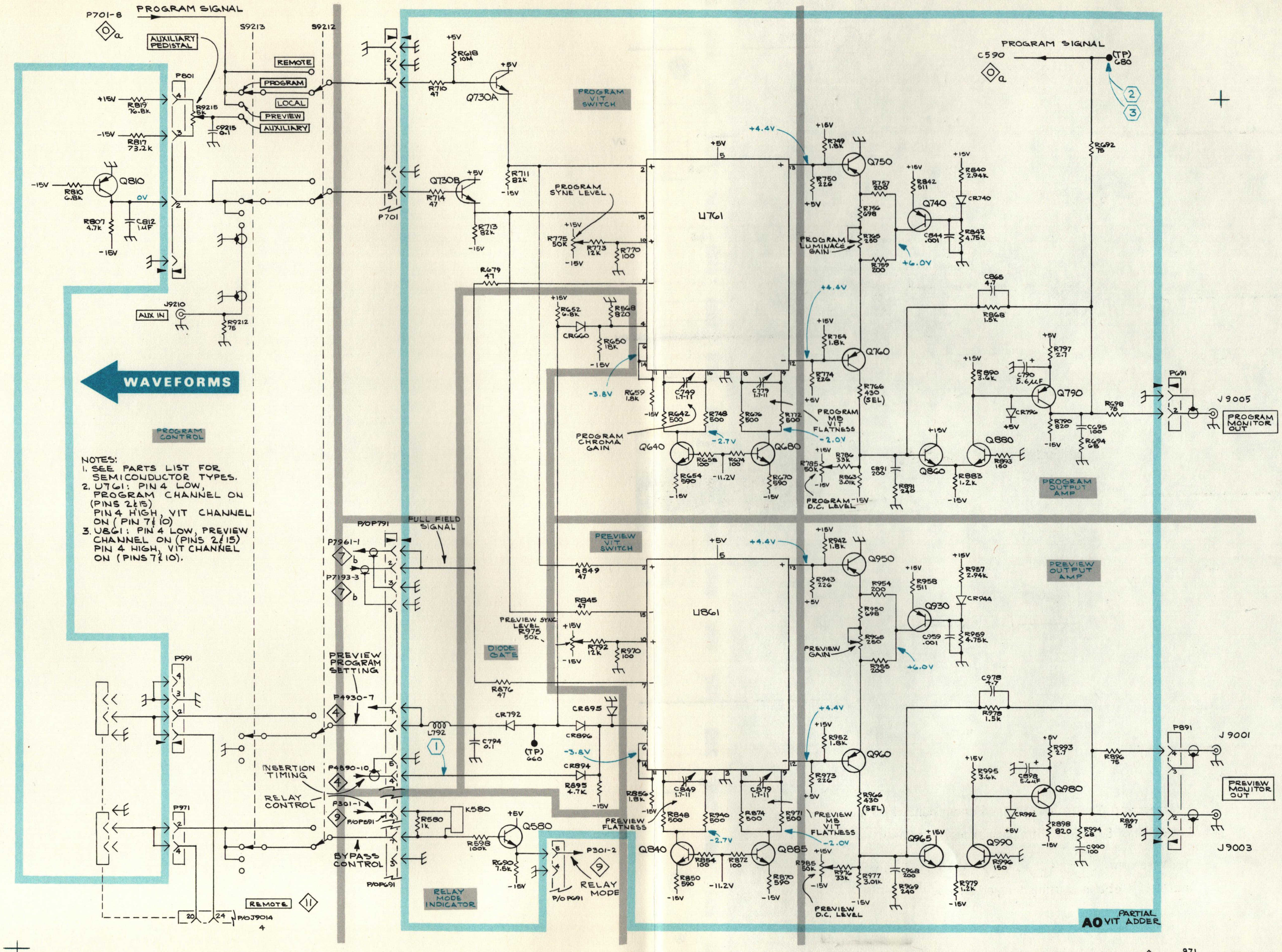
P801
1
2 orn on wht
3 blk-red on wht
4 blk-brn on wht

P911
1
2 red-blu on wht
3
4
5

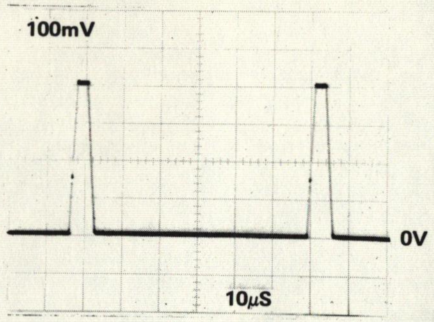
P991
1 red on wht
2 red on wht
3 blk
4

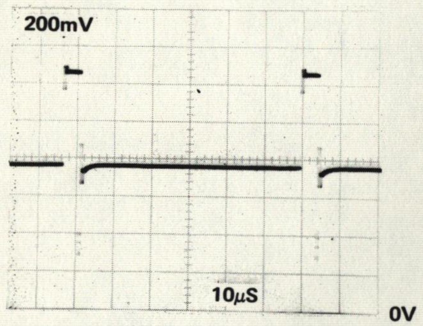
P971
1 brn on wht
2 brn on wht

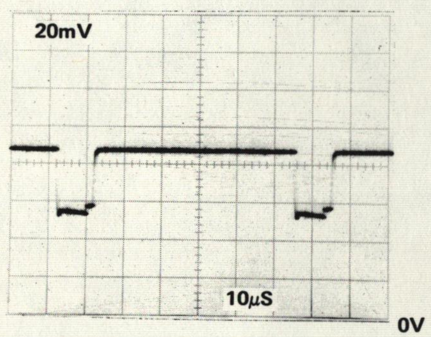
VIT INSERTION

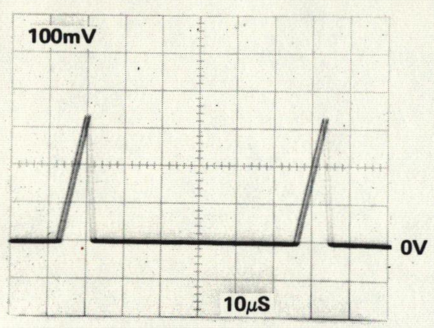


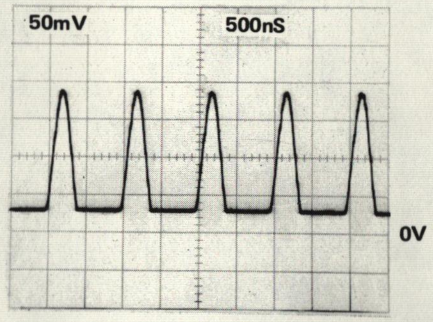
VIT INSERTION Below SN B070000 ◇b

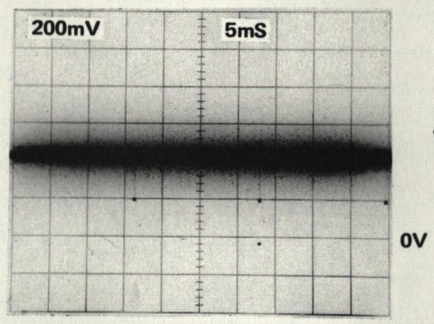
1


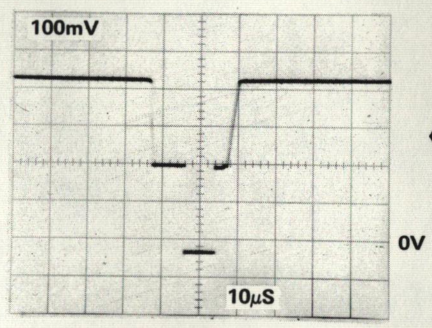
2


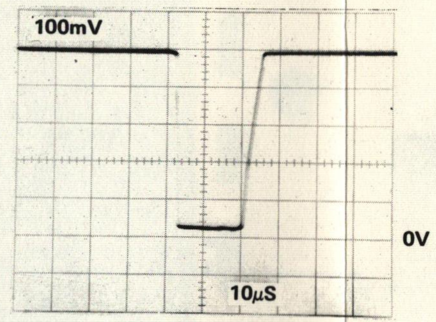
3


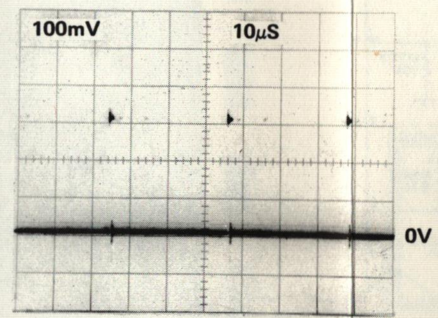
4


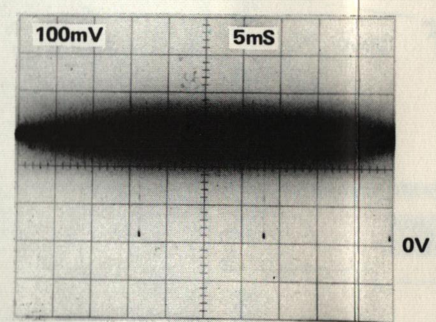
5


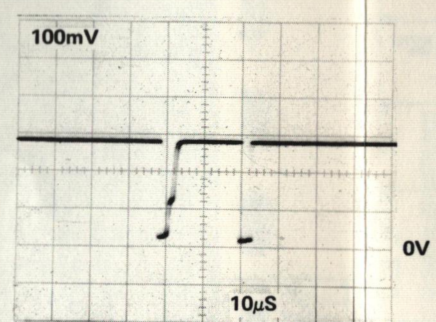
6


7


8


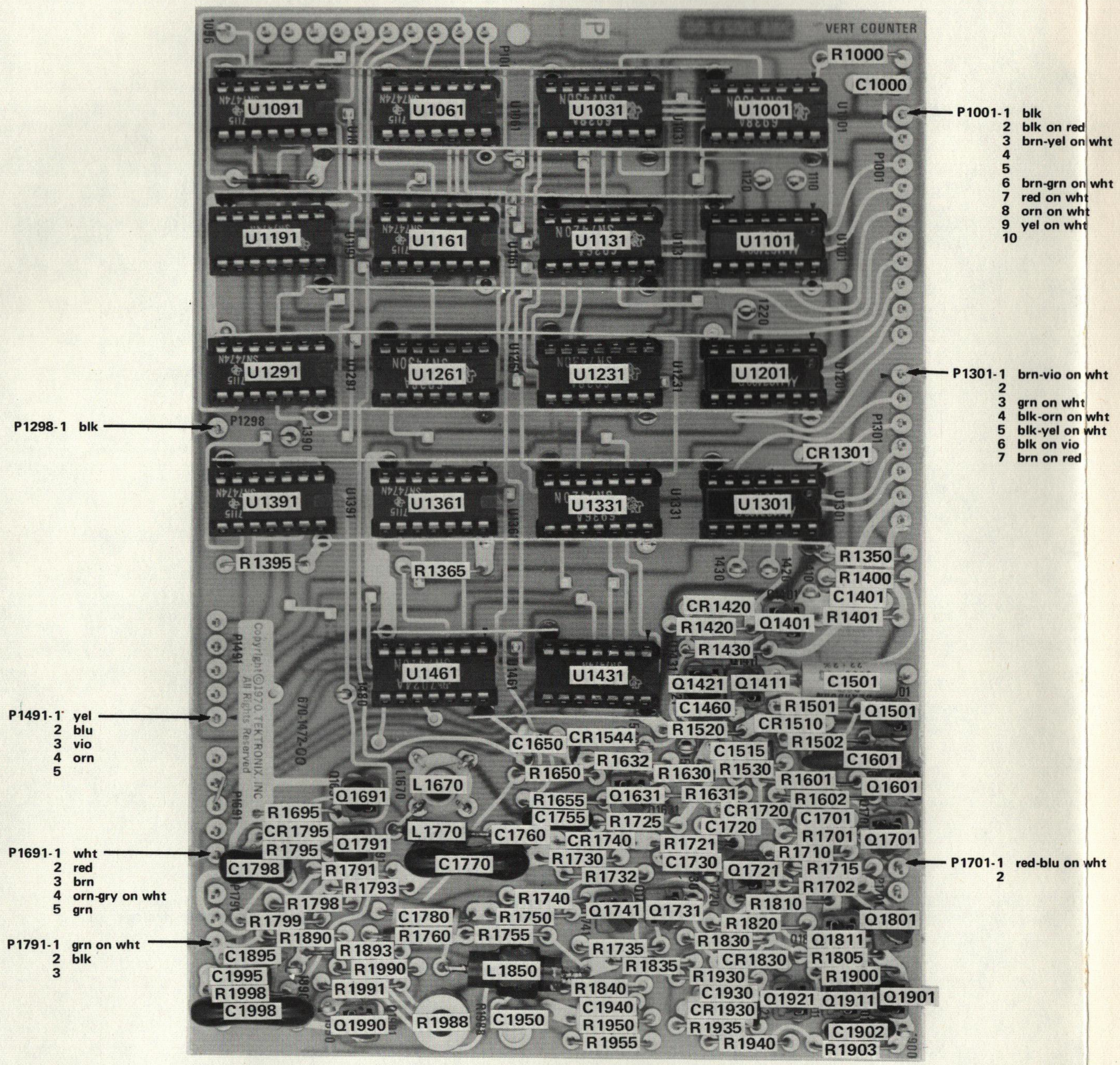
9


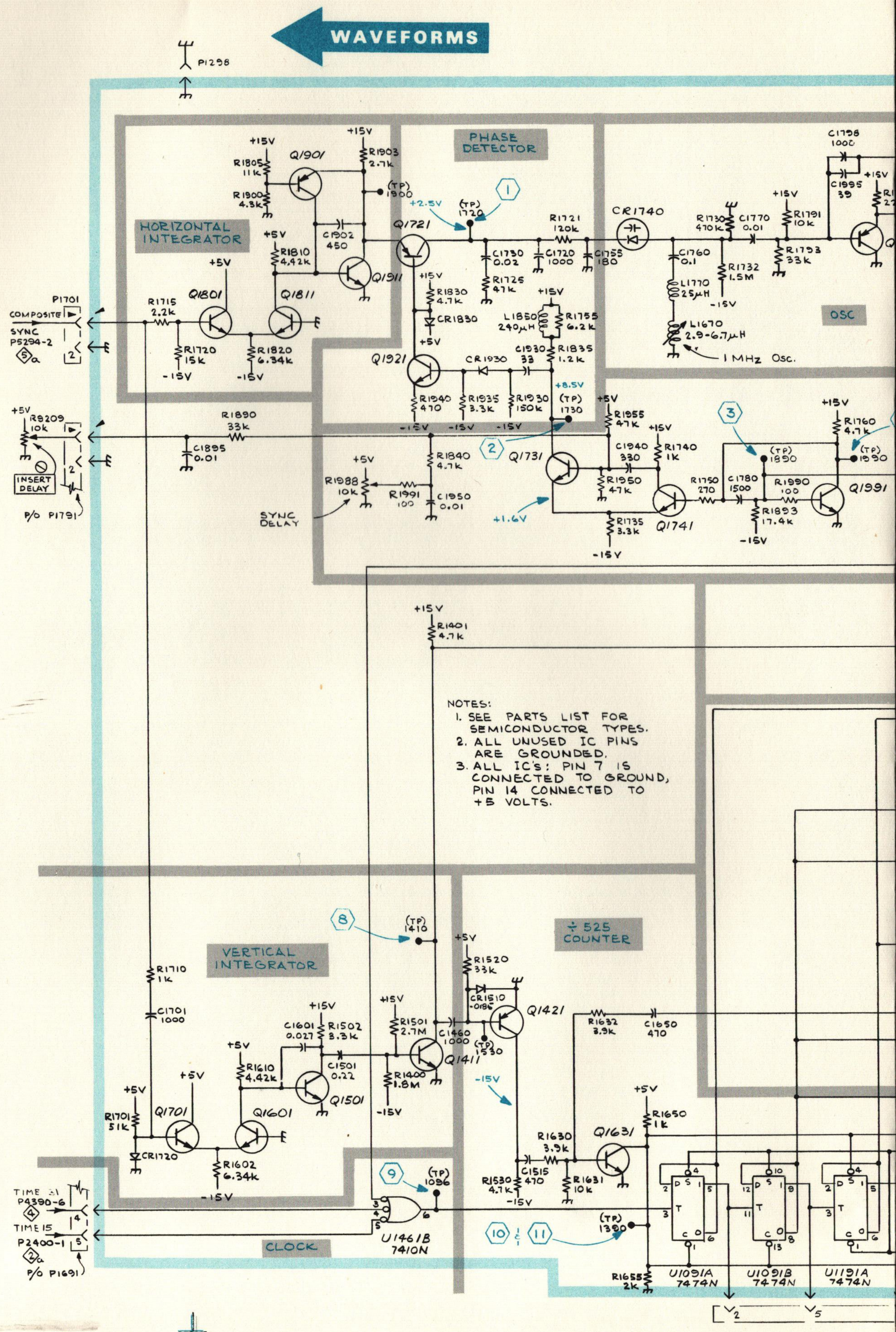
10


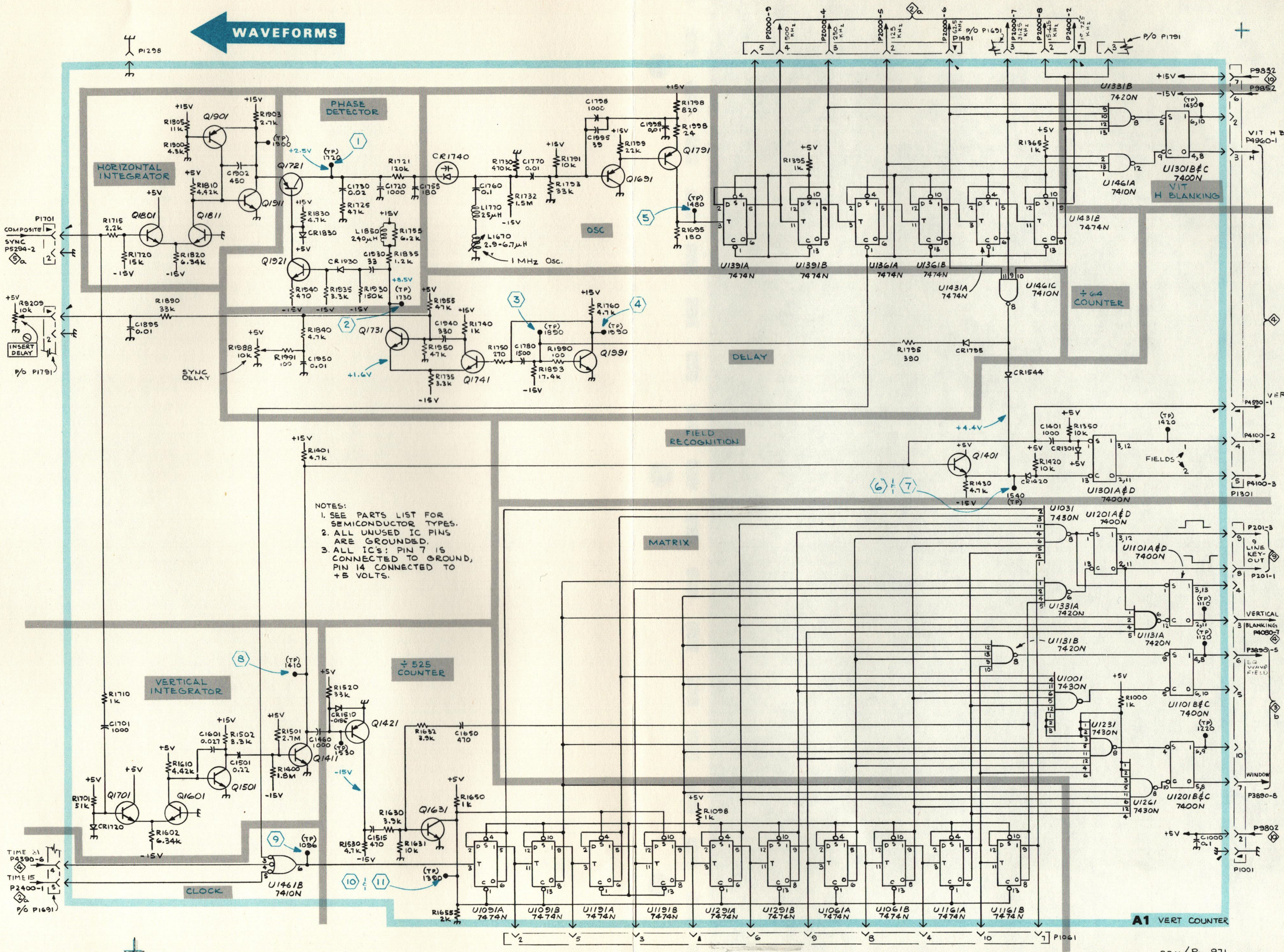
11


Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page except as follows:

1. Waveforms 1, 2, 3, 4, 7, 8, and 11 obtained using delayed sweep.

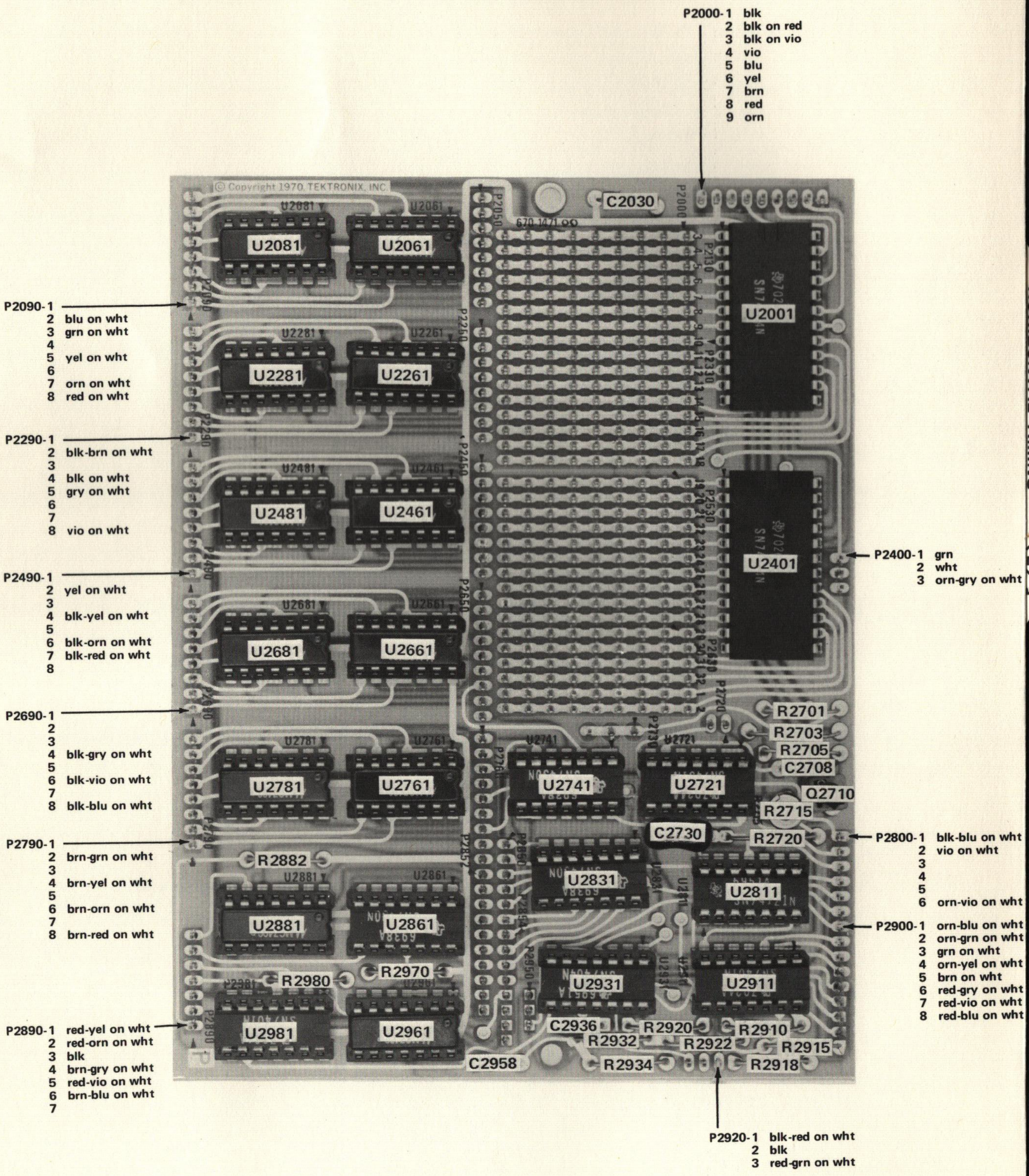

VERT COUNTER
P1001-1 blk
2 blk on red
3 brn-yel on wht
4
5
6 brn-grn on wht
7 red on wht
8 orn on wht
9 yel on wht
10
P1301-1 brn-vio on wht
2
3 grn on wht
4 blk-orn on wht
5 blk-yel on wht
6 blk on vio
7 brn on red
P1298-1 blk
P1491-1 yel
2 blu
3 vio
4 orn
5
P1691-1 wht
2 red
3 brn
4 orn-gry on wht
5 grn
P1791-1 grn on wht
2 blk
3
P1701-1 red-blu on wht
2


WAVEFORMS
HORIZONTAL INTEGRATOR
PHASE DETECTOR
OSC
1 MHz Osc.
SYNC DELAY
INSERT DELAY
VERTICAL INTEGRATOR
÷ 525 COUNTER
CLOCK
NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
2. ALL UNUSED IC PINS ARE GROUNDED.
3. ALL IC's: PIN 7 IS CONNECTED TO GROUND, PIN 14 CONNECTED TO +5 VOLTS.
U1461B 7410N
U1091A 7474N
U1091B 7474N
U1191A 7474N

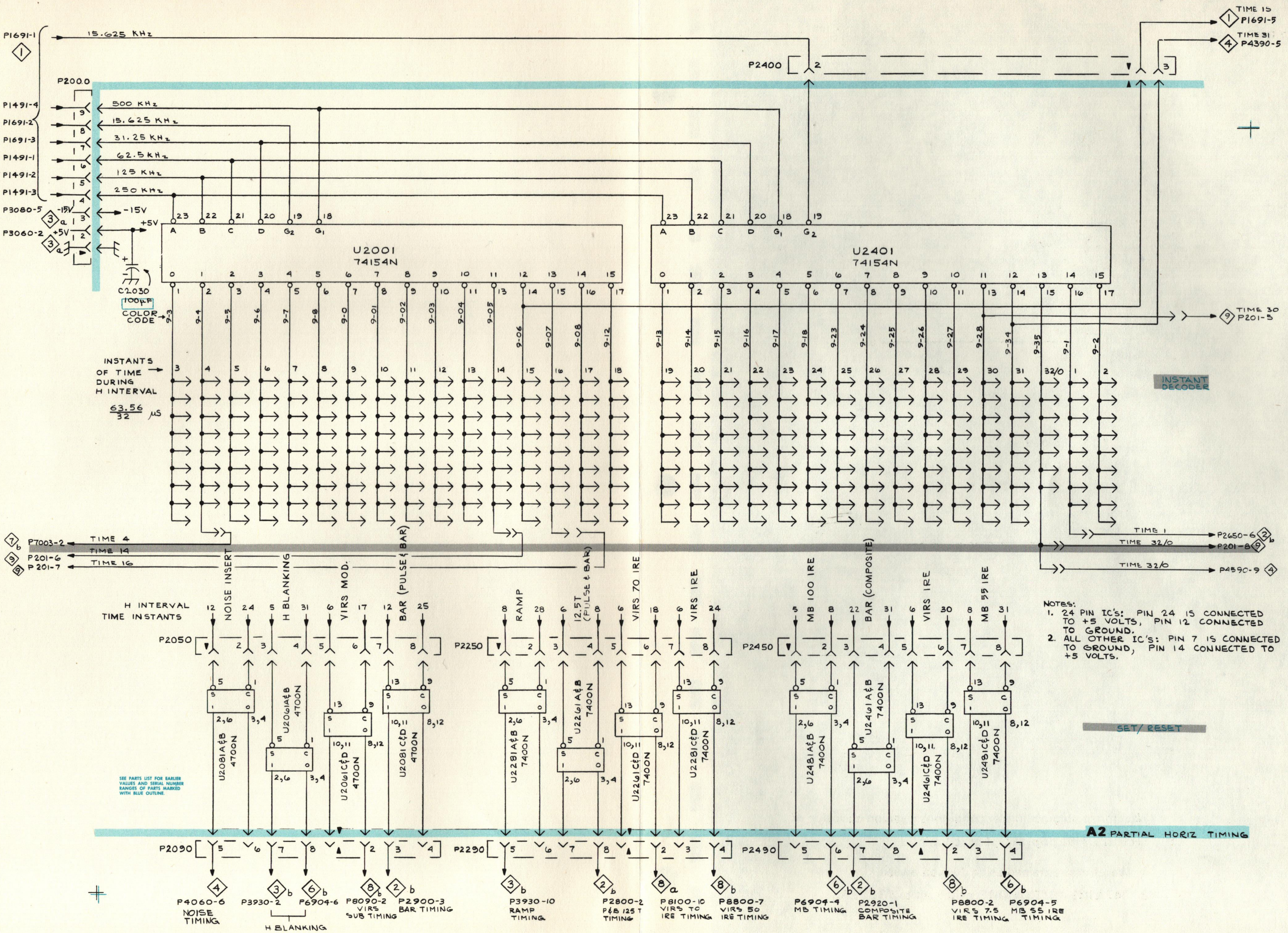


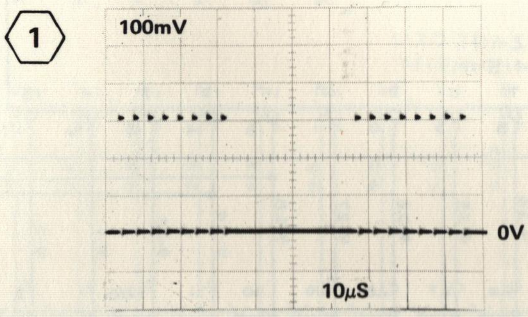
RBH/RH 971

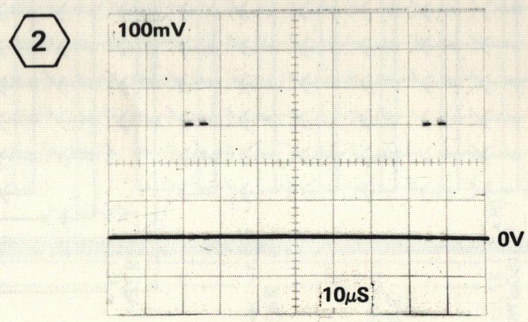
HORIZONTAL & VERTICAL COUNTERS 1



HORIZONTAL TIMING


15.625 KHz
P2400
P200.0
500 KHz
15.625 KHz
31.25 KHz
62.5 KHz
125 KHz
250 KHz
-15V
+5V
C2030
100µF
COLOR CODE
U2001
74154N
U2401
74154N
TIME 15 P1691-5
TIME 31 P4390-5
TIME 30 P201-5
INSTANTS OF TIME DURING H INTERVAL
63.56/32 µS
INSTANT DECODER
TIME 4
TIME 14
TIME 16
TIME 1
TIME 32/0
NOISE INSERT
H BLANKING
VIRS MOD.
BAR (PULSE & BAR)
RAMP
12.5T (PULSE & BAR)
VIRS 70 IRE
VIRS IRE
MB 100 IRE
BAR (COMPOSITE)
MB 55 IRE
H INTERVAL TIME INSTANTS
P2050
P2250
P2450
NOTES:
1. 24 PIN IC's: PIN 24 IS CONNECTED TO +5 VOLTS, PIN 12 CONNECTED TO GROUND.
2. ALL OTHER IC's: PIN 7 IS CONNECTED TO GROUND, PIN 14 CONNECTED TO +5 VOLTS.
SET/RESET
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
A2 PARTIAL HORIZ TIMING
P2090
P2290
P2490
P4060-6 NOISE TIMING
P3930-2
P6904-6
H BLANKING
P8090-2 VIRS SUB TIMING
P2900-3 BAR TIMING
P3930-10 RAMP TIMING
P2800-2 P&B 12.5 T TIMING
P8100-10 VIRS TO IRE TIMING
P8800-7 VIRS 50 IRE TIMING
P6904-4 MB TIMING
P2920-1 COMPOSITE BAR TIMING
P8800-2 VIRS 7.5 IRE TIMING
P6904-5 MB 55 IRE TIMING

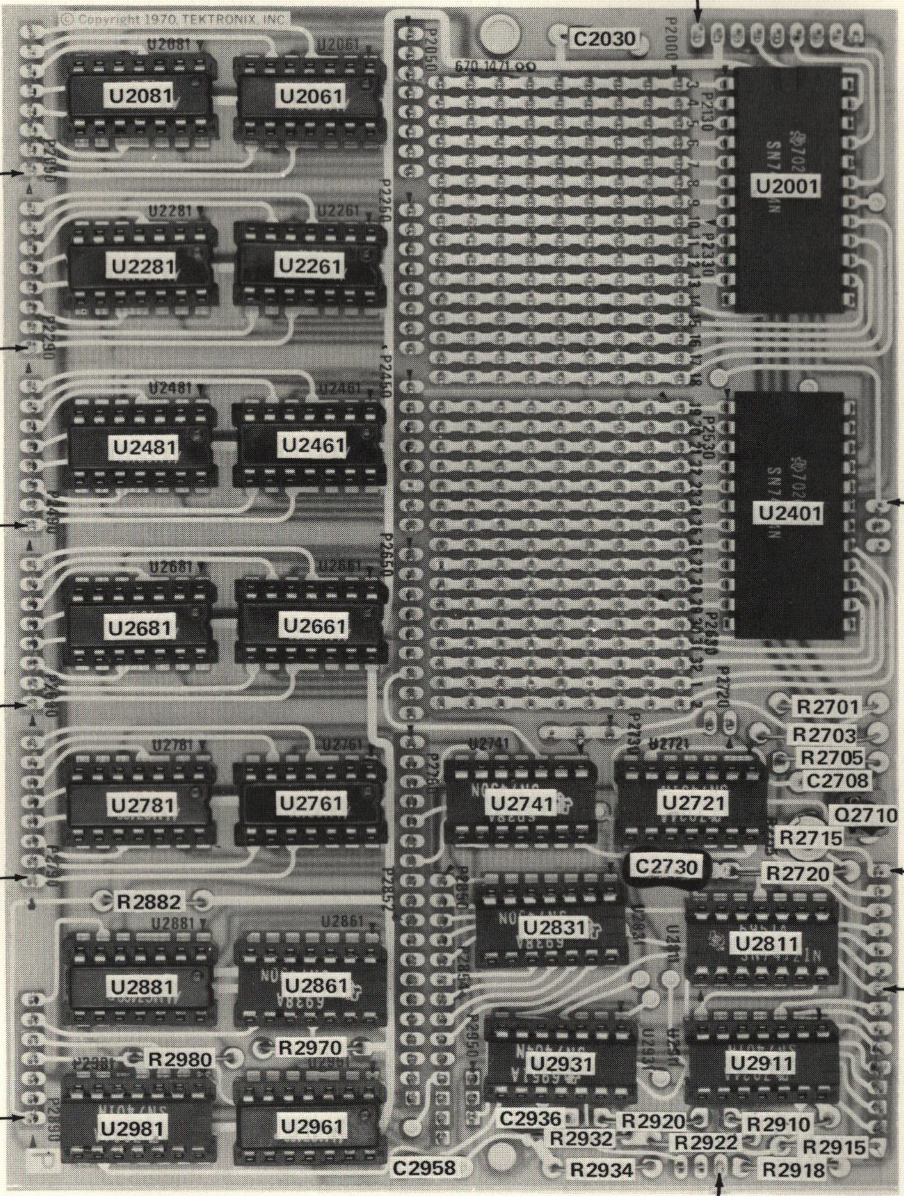




Waveforms obtained under conditions given on back side of Section 7 Title page except as follows:

1. Waveforms obtained using delayed Sweep.
2. 147 LINEARITY MODE switch set to 10 STEP.

P2000-1 blk
2 blk on red
3 blk on vio
4 vio
5 blu
6 yel
7 brn
8 red
9 orn



P2090-1
2 blu on wht
3 grn on wht
4
5 yel on wht
6
7 orn on wht
8 red on wht

P2290-1
2 blk-brn on wht
3
4 blk on wht
5 gry on wht
6
7
8 vio on wht

P2490-1
2 yel on wht
3
4 blk-yel on wht
5
6 blk-orn on wht
7 blk-red on wht
8

P2690-1
2
3
4 blk-gry on wht
5
6 blk-vio on wht
7
8 blk-blu on wht

P2790-1
2 brn-grn on wht
3
4 brn-yel on wht
5
6 brn-orn on wht
7
8 brn-red on wht

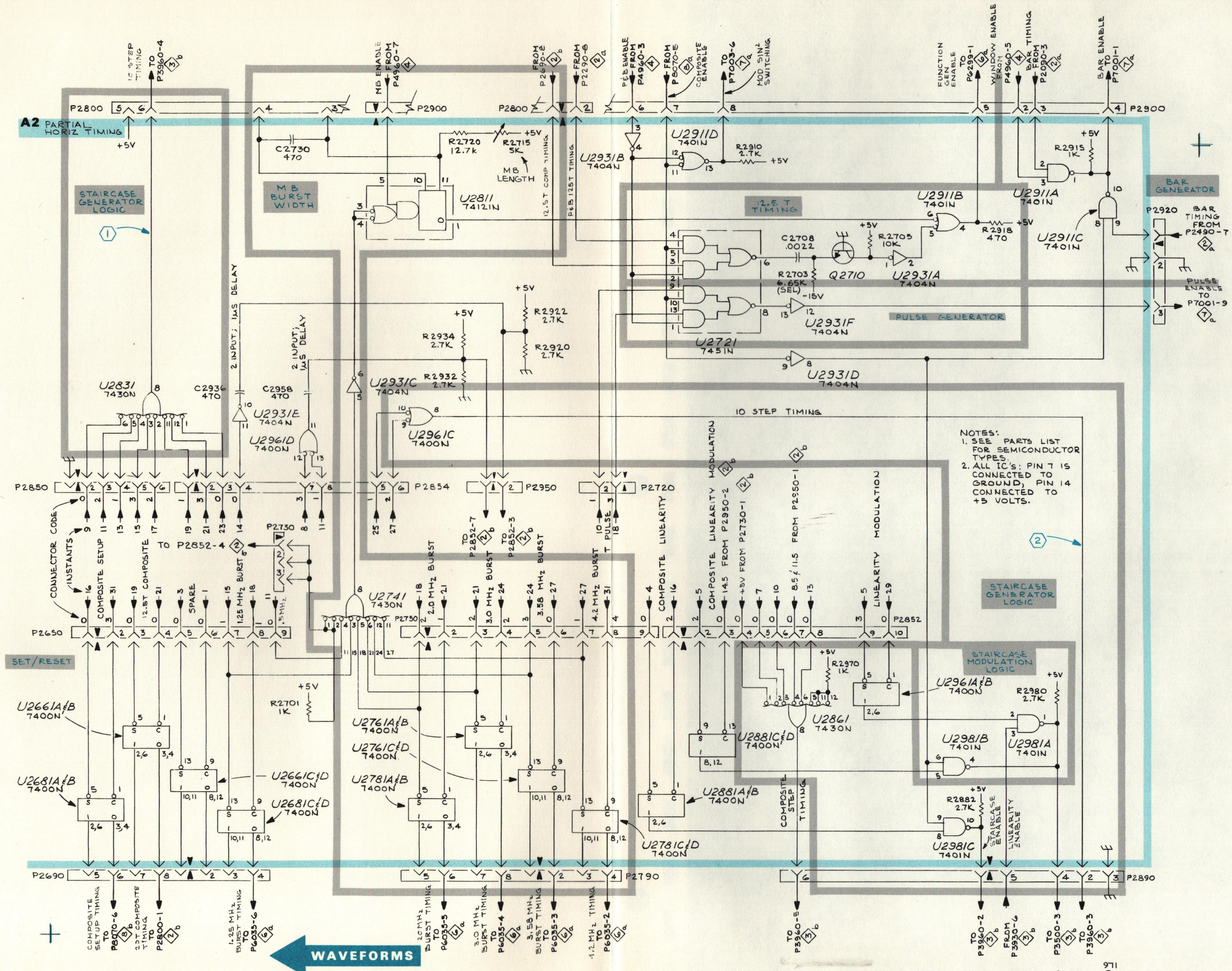
P2890-1 red-yel on wht
2 red-orn on wht
3 blk
4 brn-gry on wht
5 red-vio on wht
6 brn-blu on wht
7

P2400-1 grn
2 wht
3 orn-gry on wht

P2800-1 blk-blu on wht
2 vio on wht
3
4
5
6 orn-vio on wht

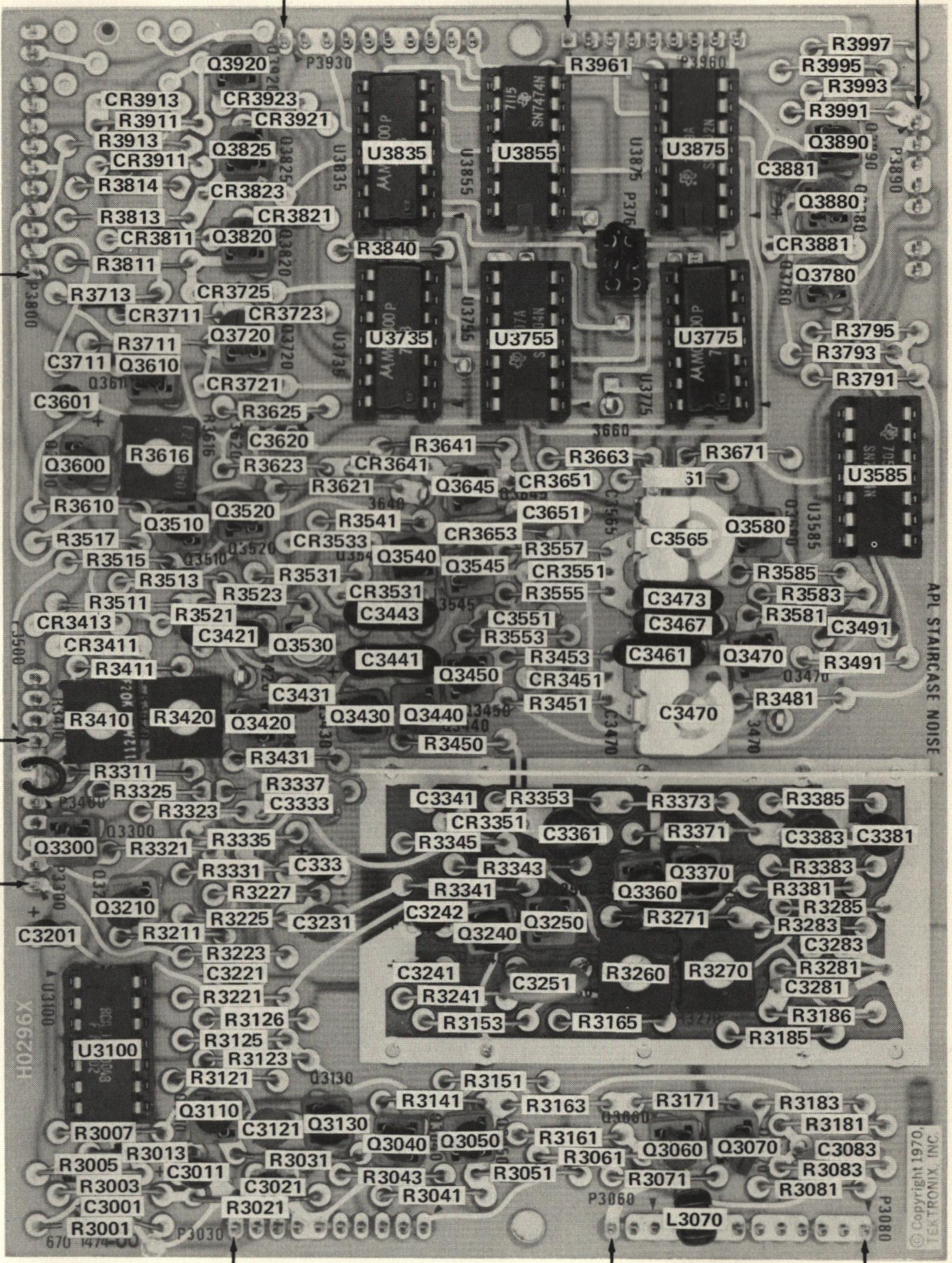
P2900-1 orn-blu on wht
2 orn-grn on wht
3 grn on wht
4 orn-yel on wht
5 brn on wht
6 red-gry on wht
7 red-vio on wht
8 red-blu on wht

P2920-1 blk-red on wht
2 blk
3 red-grn on wht

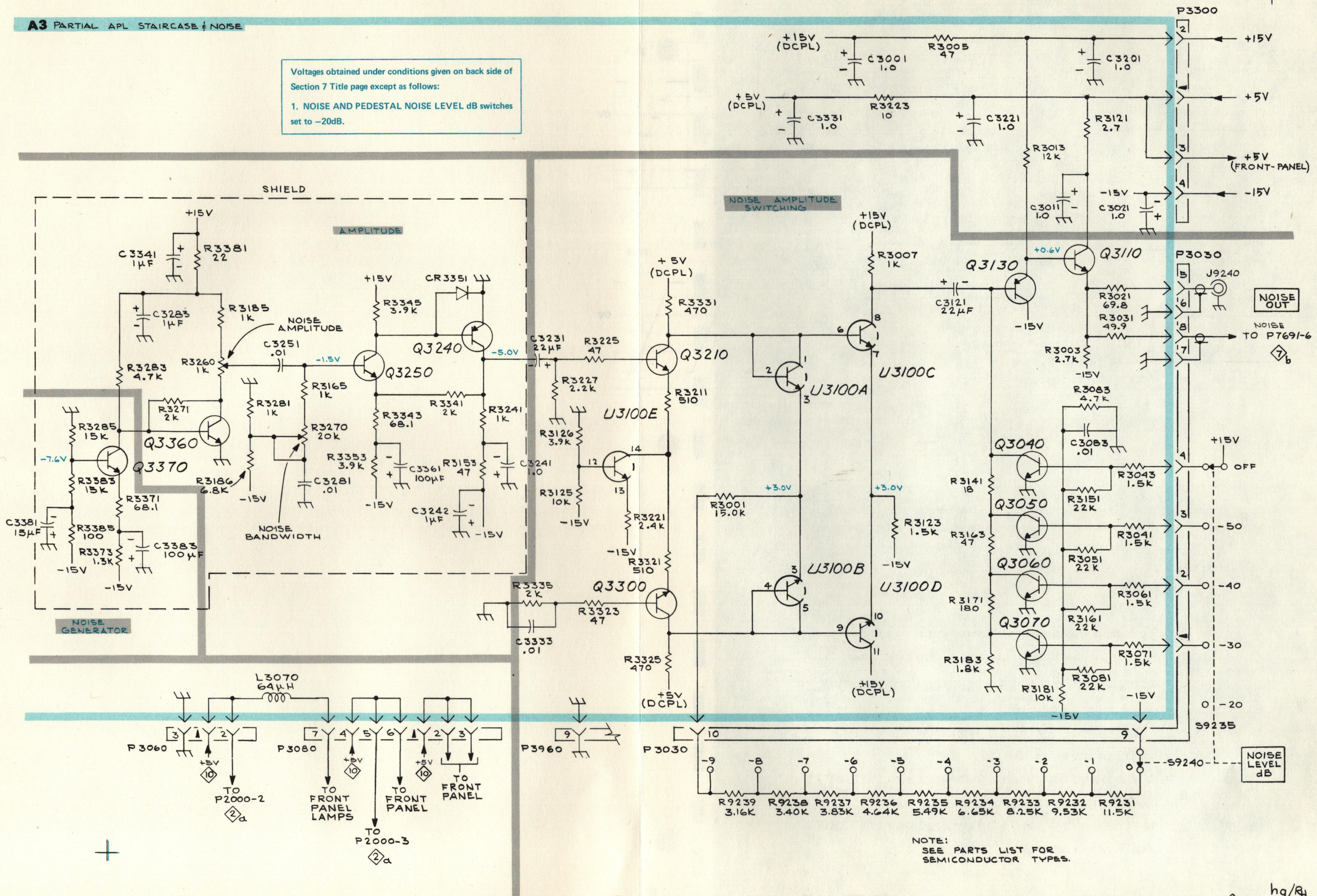


147/R147

HORIZONTAL TIMING 2b

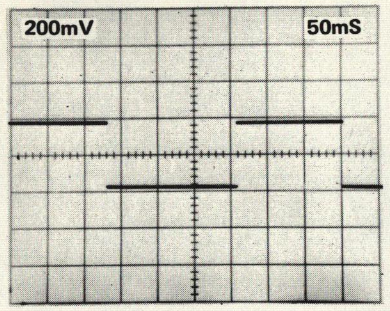


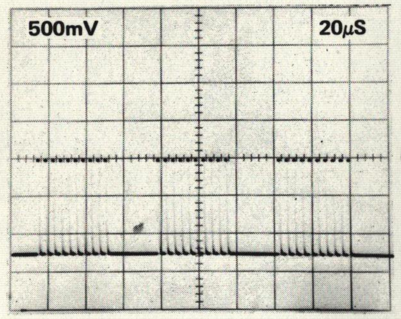
NOISE GENERATOR

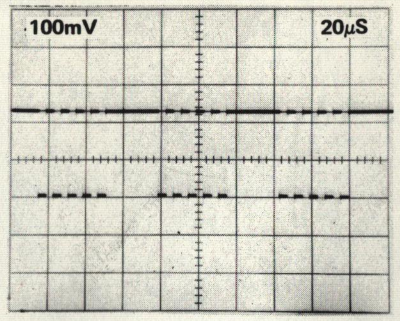


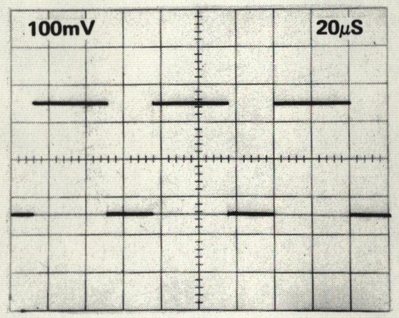
NOISE GENERATOR 3a

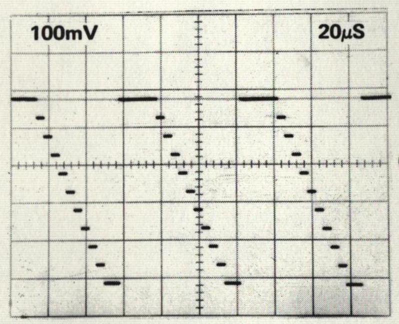
hq/RL 971

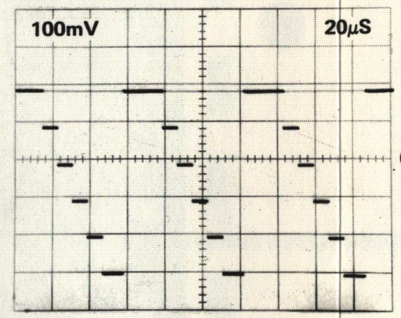
1


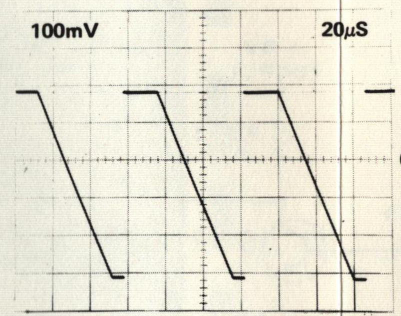
2


3


4


5


6


7


Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page except as follows:

1. Waveform (1) obtained with FULL FIELD SIG MODE switch set to FLAT FIELD.

2. Waveforms (2) and (5) obtained with LINEARITY MODE switch set to 10 STEP.

3. Waveforms (3) and (6) obtained with LINEARITY MODE switch set to 5 STEP.

4. Waveforms (4) and (7) obtained with LINEARITY MODE switch set to RAMP.

P3930-1 blu on wht
2 orn on wht
3 orn on wht
4
5 yel-vio on wht
6 red-vio on wht
7 red-vio on wht
8
9
10 gry on wht

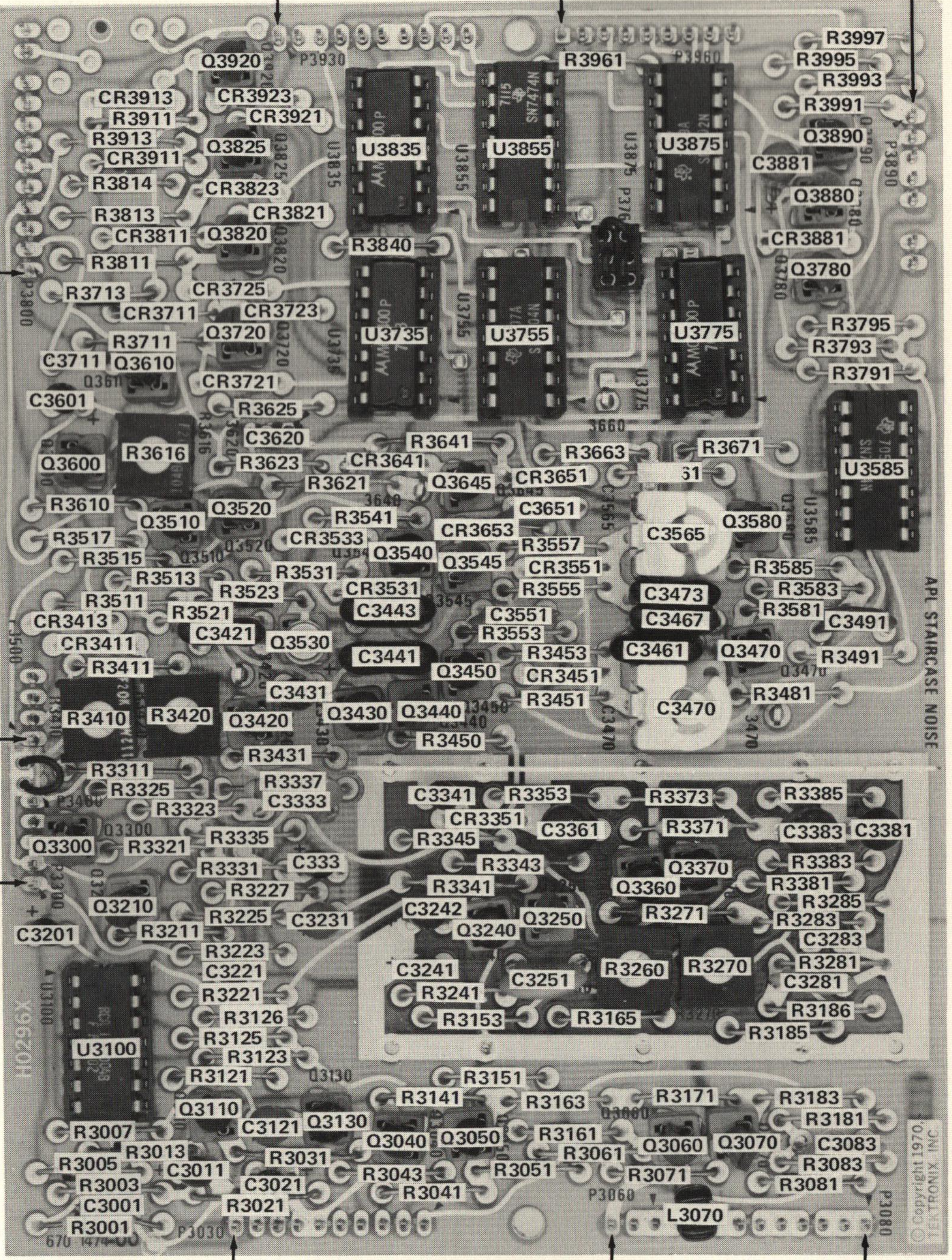
P3960-1
2 red-yel on wht
3 red-orn on wht
4 orn-vio on wht
5 brn-blu on wht
6 blk-orn on wht
7 brn-vio on wht
8 brn-gry on wht
9 blk

P3890-1 wht coax
2 shield for 1
3 yel on wht
4 yel on wht
5 brn-grn on wht
6
7 vio on wht
8 red on wht

P3800-1 gry on wht coax
2 shield for 1
3 blk
4 blk
5 blk
6 blk
7 grn on wht
8 red on wht
9
10 red on wht

P3500-1 shield for 2
2 vio on wht coax
3 brn-gry on wht
4 blk-yel on wht

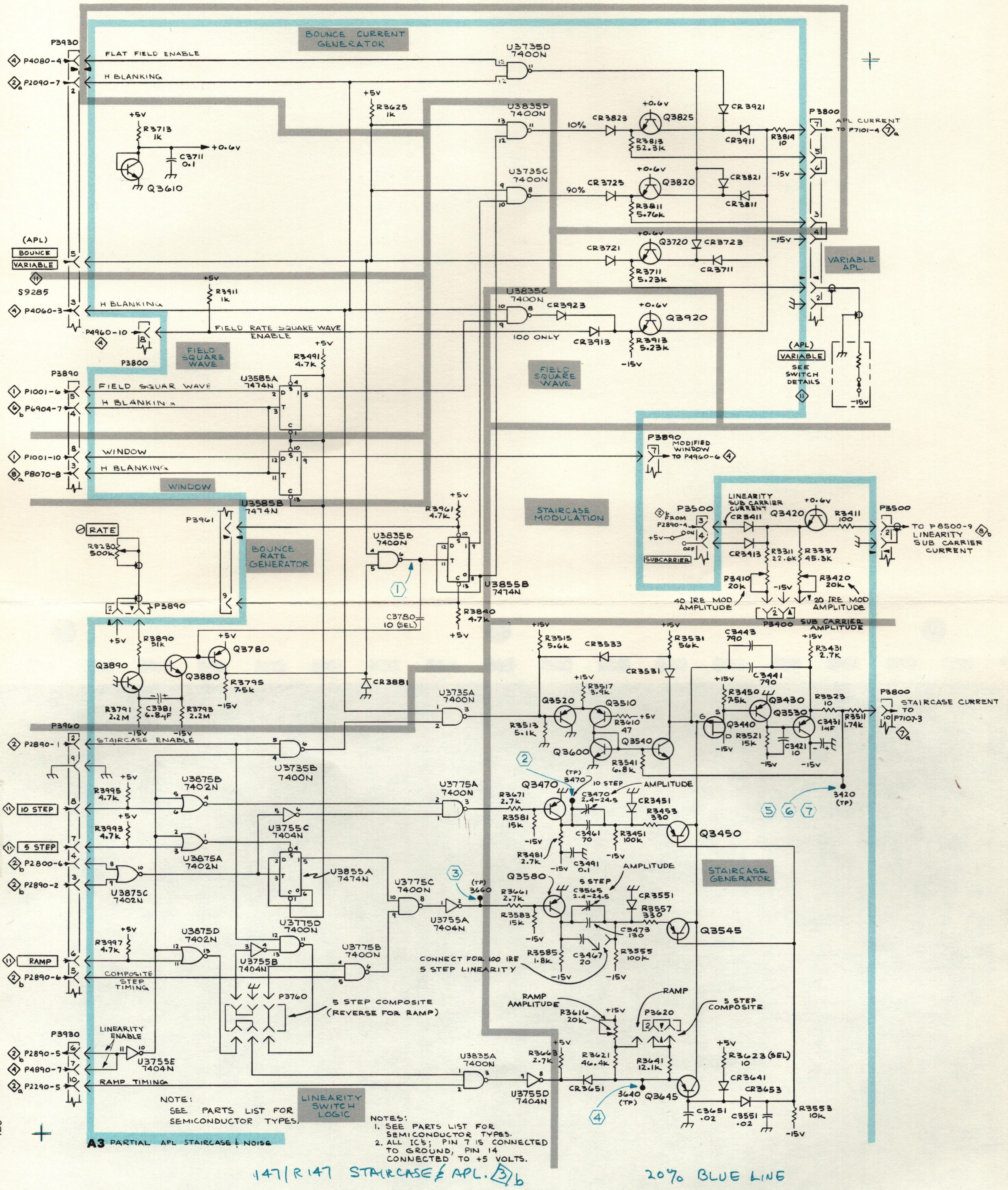
P3300-1 blk on red
2 brn on red
3 blk on red
4 blk on vio



P3030-1 yel on wht
2 orn on wht
3 red on wht
4 brn on wht
5 blu on wht coax
6 shield for 5
7 shield for 8
8 blk-vio on wht coax
9 shield for 10
10 orn on wht coax

P3060-1 blk on red
2 blk on red
3 blk

P3080-1 blk on vio
2 blk on vio
3 blk on vio
4 brn on red
5 brn on red
6 brn on red
7 blk-wht on red



147/R147

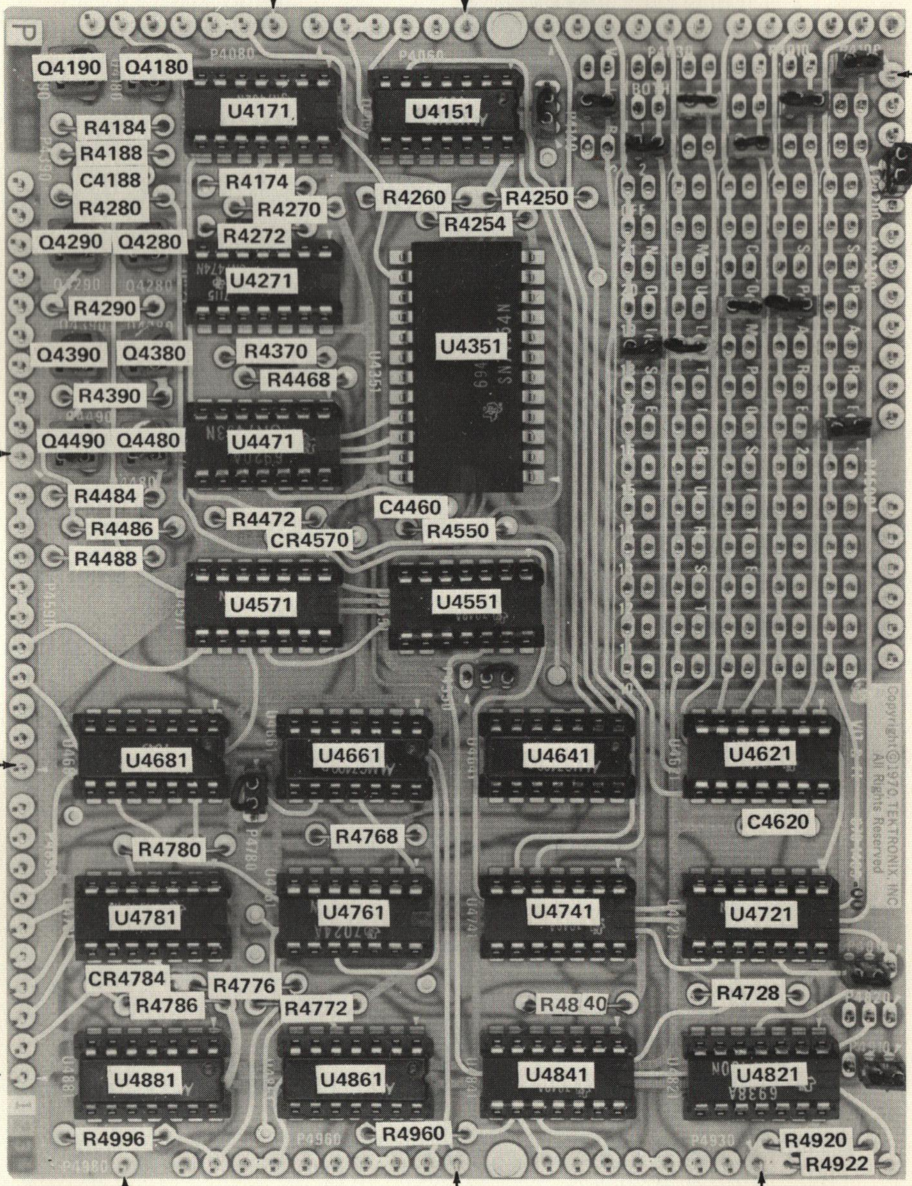
STAIRCASE & APL 3b

147/R147 STAIRCASE & APL. 3b   20% BLUE LINE

P4060-1 grn on wht
2 orn on wht
3
4 brn-red on wht
5 yel-vio on wht
6 yel on wht

P4080-1 blu on brn
2 red-vio on wht
3 red-blu on wht
4 blu on wht
5 blk-gry on wht
6
7 brn-yel on wht

P4100-1
2 blk-orn on wht
3 blk-yel on wht



P4390-1 grn on brn
2 yel on wht
3 yel on wht
4 yel on brn
5 orn-gry on wht
6 orn-gry on wht
7 orn on brn
8 blk
9 brn
10 yel-blu on wht

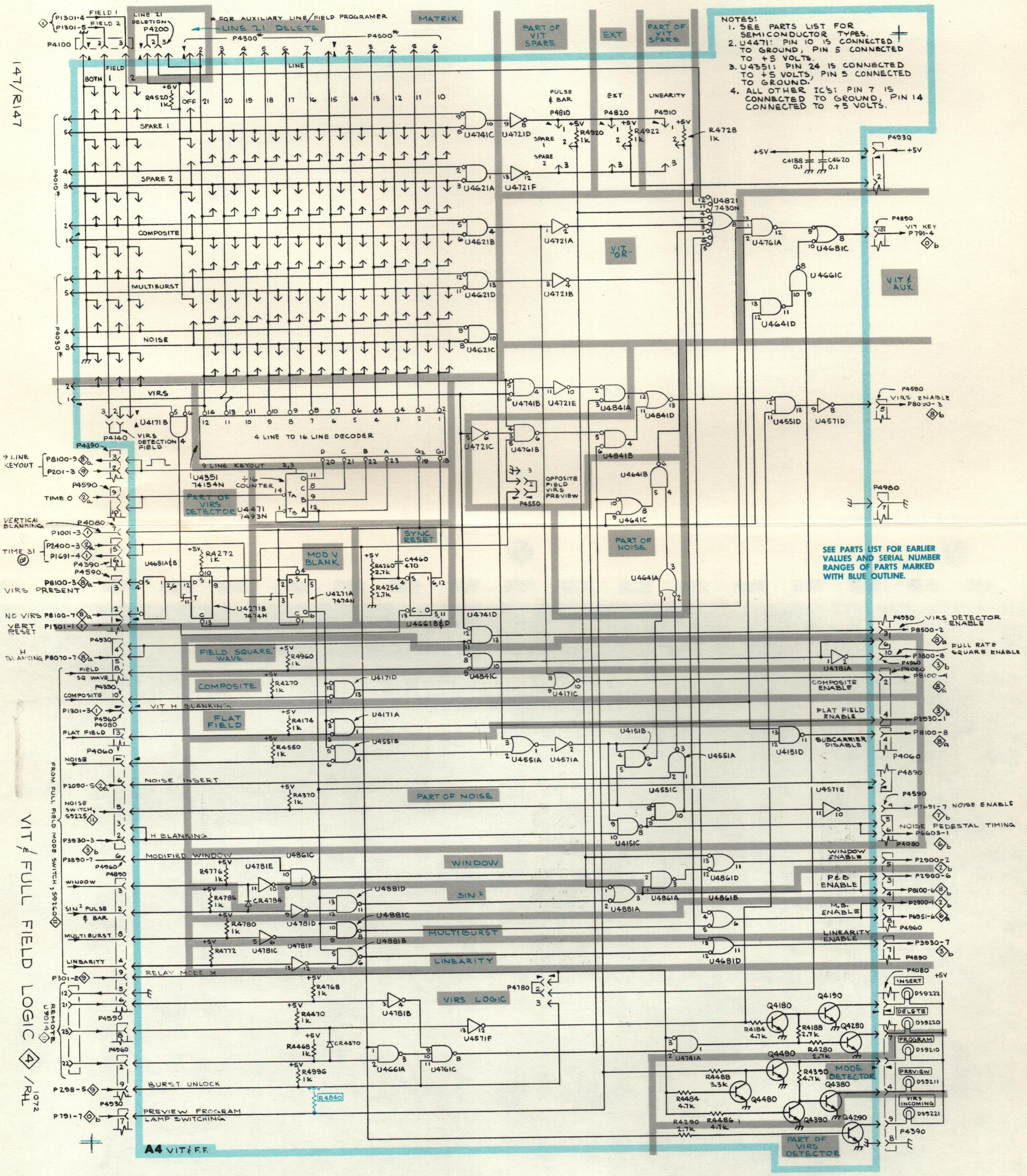
P4590-1 brn-vio on wht
2 red-blu on wht
3 red-grn on wht
4 grn-yel on wht
5 grn-blu on wht
6
7
8 grn-gry on wht
9
10 blk-gry on wht

P4890-1
2 orn on wht
3 blk-red on wht
4 blk-brn on wht
5 red-orn on wht
6 grn-blu on wht
7 red-vio on wht
8 red-gry on wht
9 blk-blu on wht
10 brn-yel on wht

P4980-1 blk

P4960-1 grn on wht
2 yel-gry on wht
3 red-gry on wht
4 red-gry on wht
5 orn-grn on wht
6 vio on wht
7 orn-blu on wht
8 orn-blu on wht
9 gry on wht
10 red on wht

P4930-1 blk on red
2
3 blk-red on wht
4 yel on wht
5
6
7 yel-blu on wht
8 yel-grn on wht

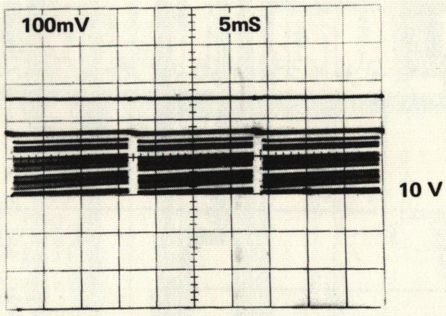


14T/R147

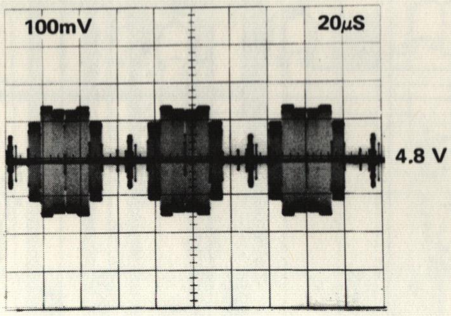
VIT/ FULL FIELD LOGIC ④ /RL 1072

VIT & FULL FIELD LOGIC ④

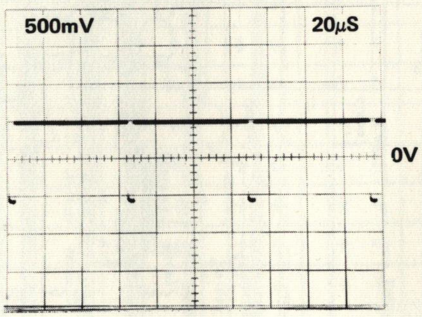
1



2



3



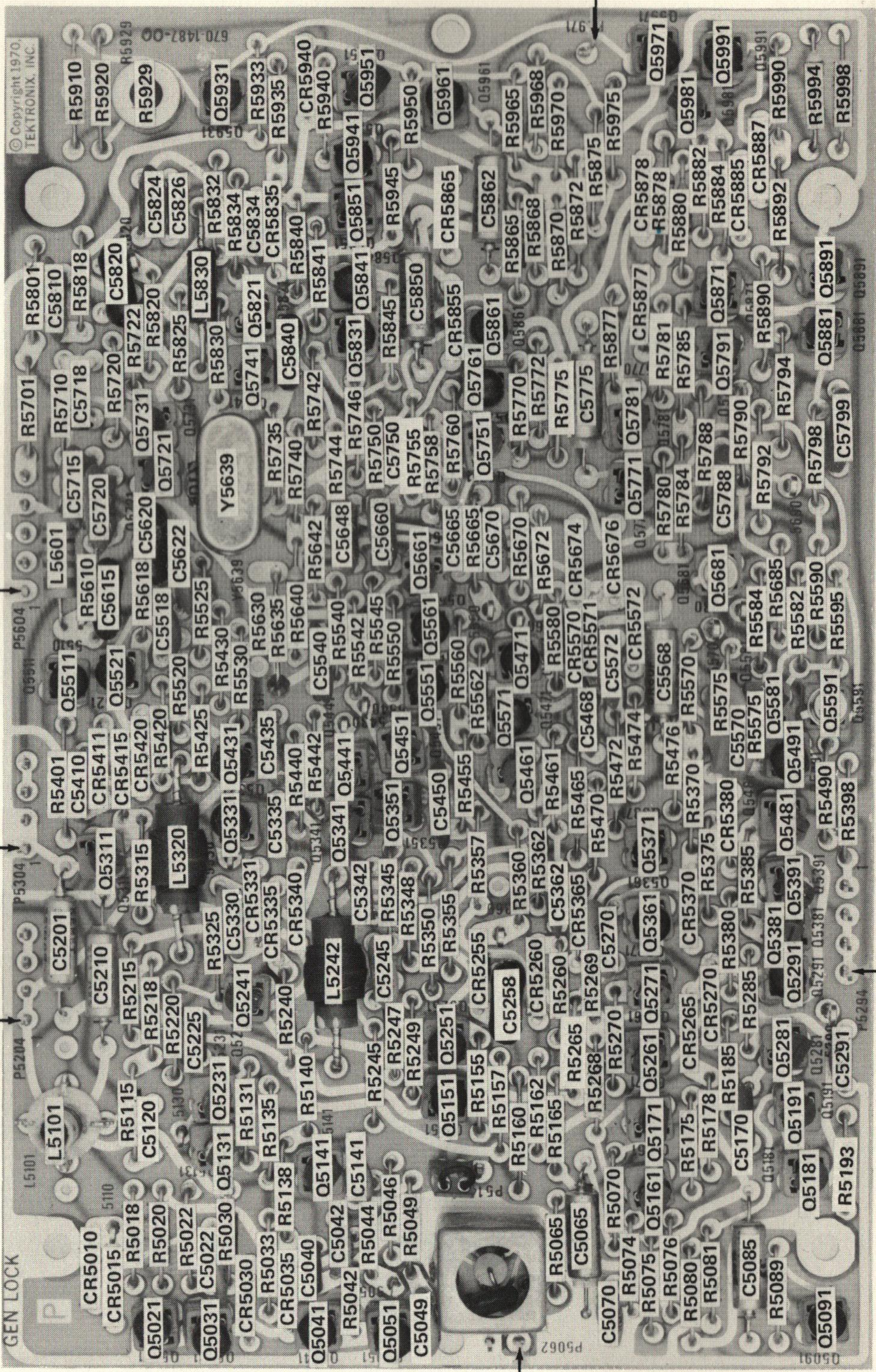
P5971-1 gry on wht

P5604-1 shield for 2
2 blk-grn on wht coax
3
4 shield for 5
5 wht coax

P5304-1
2
3 blk on red
4

P5204-1
2 brn on red
3 blk on vio
4

L5055
C5050
C5048
R5050
R5052
R5055
R5060
} Located in shield CAN



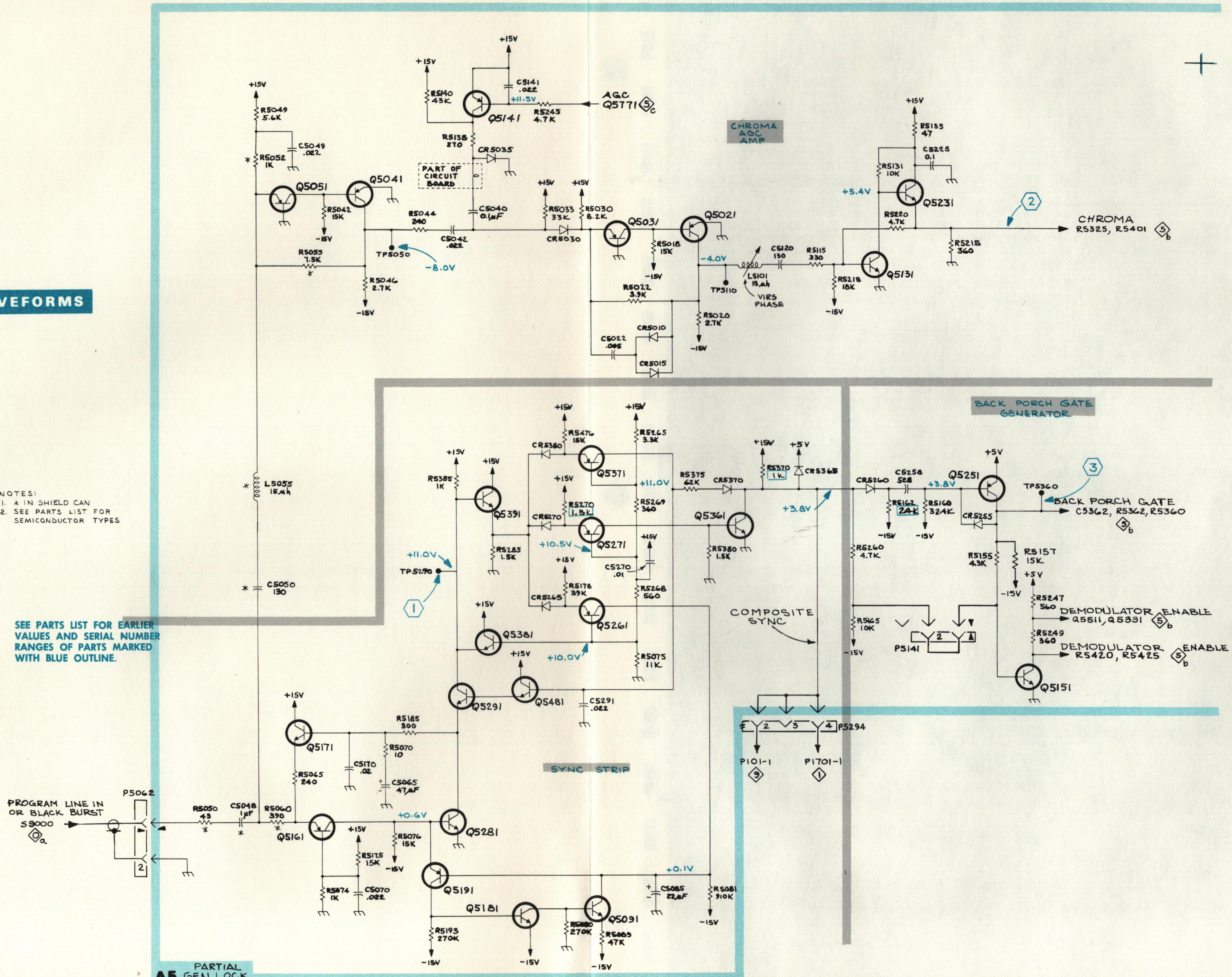
P5062-1 blk-brn on wht coax
2 shield for 1

P5294-1 brn-red on wht
2 red-blu on wht
3 red-blu on wht
4

WAVEFORMS

NOTES:
1. * IN SHIELD CAN
2. SEE PARTS LIST FOR SEMICONDUCTOR TYPES

SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.

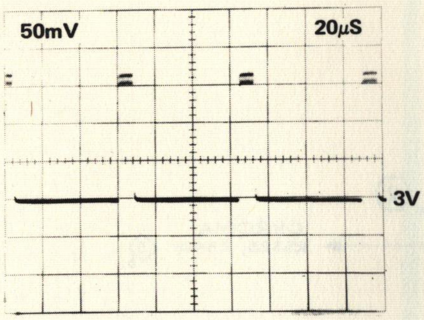


SYNC STRIP & CHROMA AGC AMP 5a

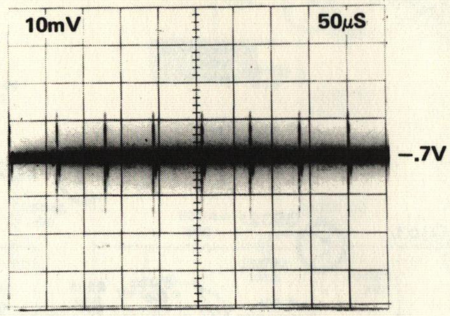
1072 /RH

SYNC STRIP & CHROMA AGC AMP 5a

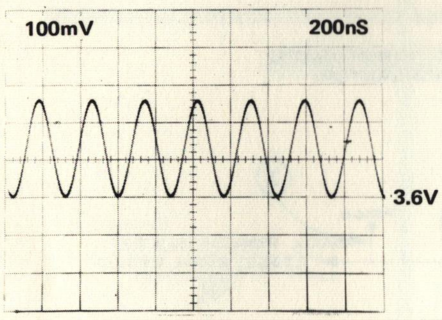
1



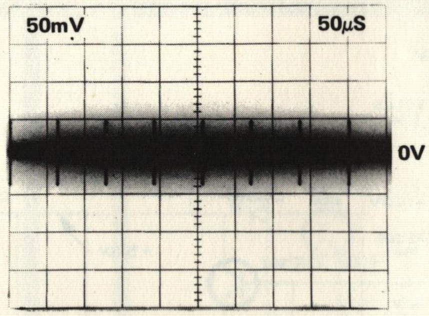
4



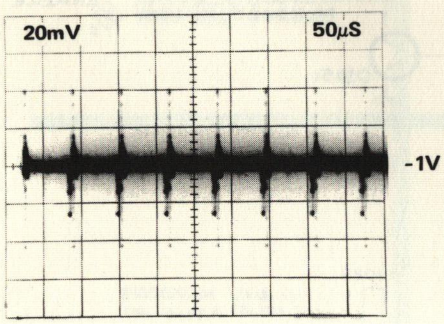
2



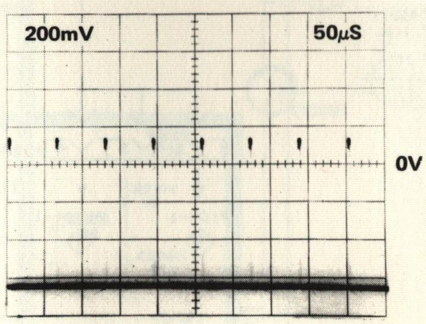
5



3



6



Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page except as follows:

1. Waveform ⟨2⟩ obtained using internal triggering.

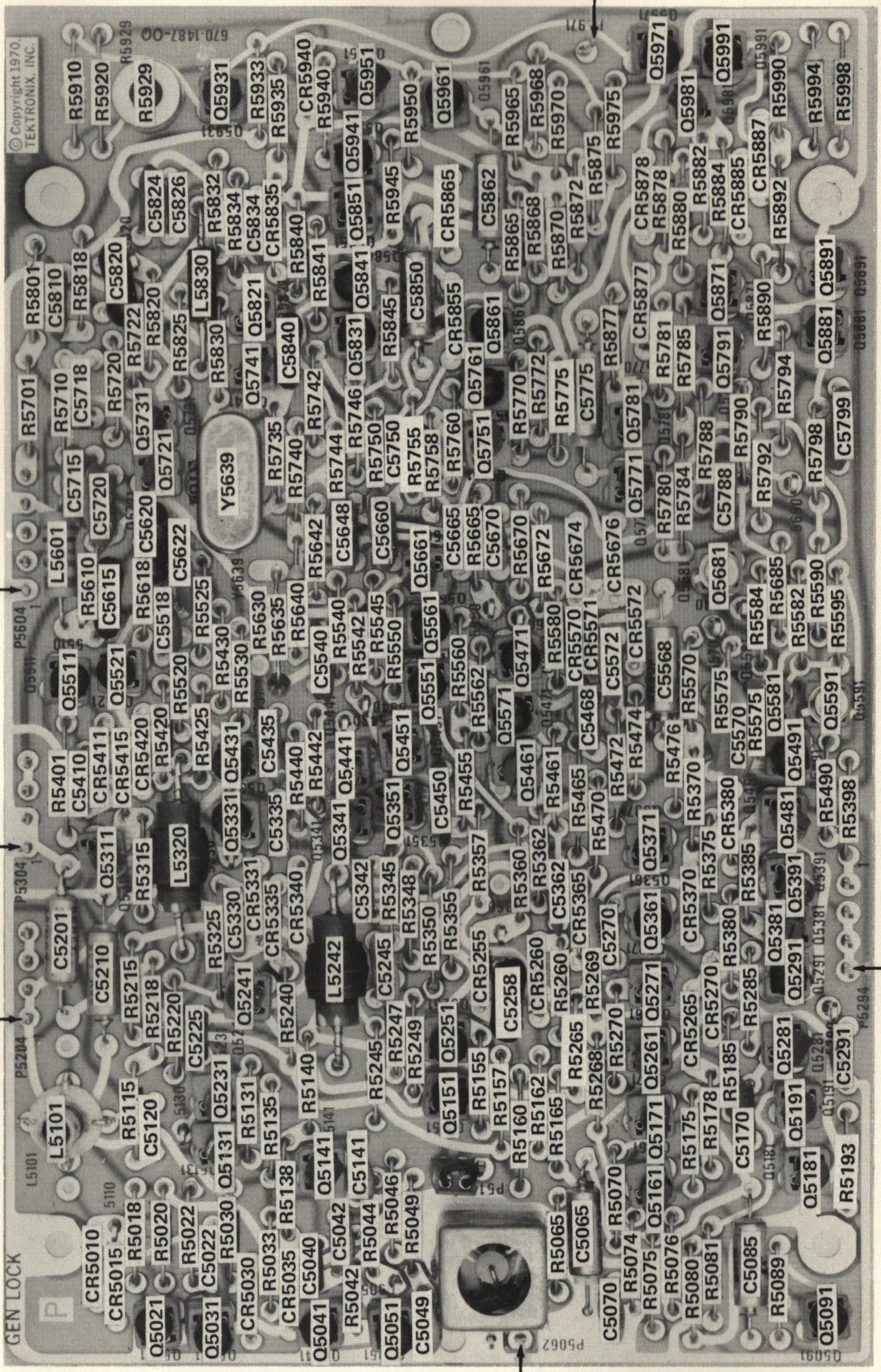
P5971-1 gry on wht

P5604-1 shield for 2
2 blk-grn on wht coax
3
4 shield for 5
5 wht coax

P5304-1
2
3 blk on red
4

P5204-1
2 brn on red
3 blk on vio
4

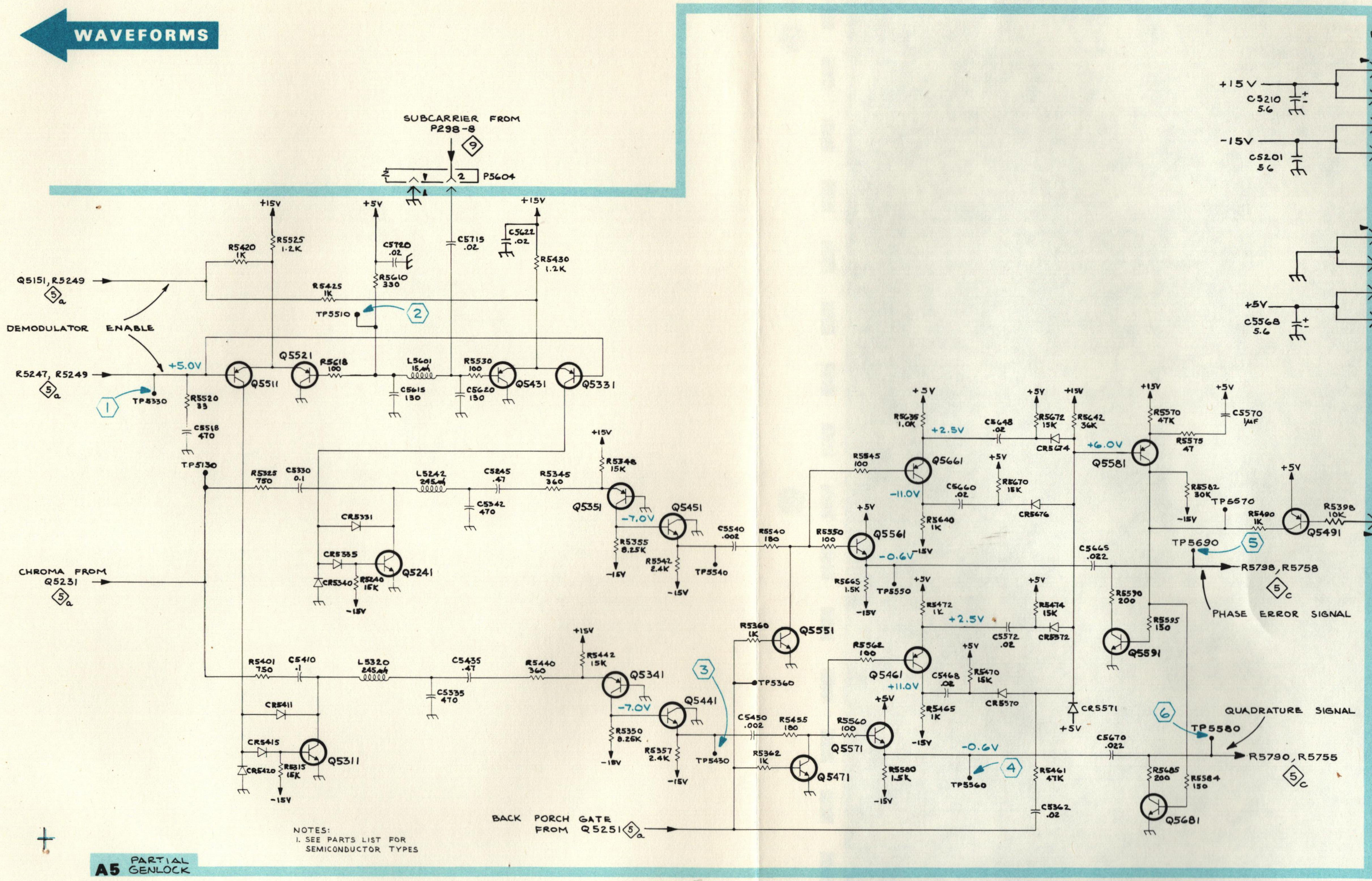
L5055
C5050
C5048
R5050
R5052
R5055
R5060
} Located in shield CAN



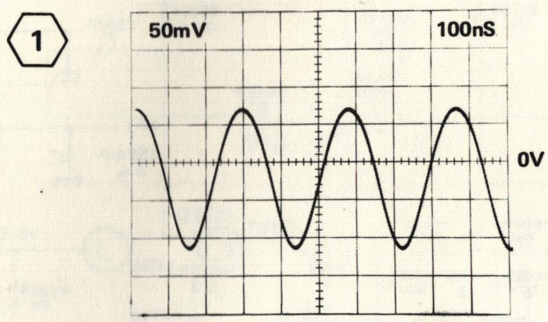
P5062-1 blk-brn on wht coax
2 shield for 1

P5294-1 brn-red on wht
2 red-blu on wht
3 red-blu on wht
4

WAVEFORMS

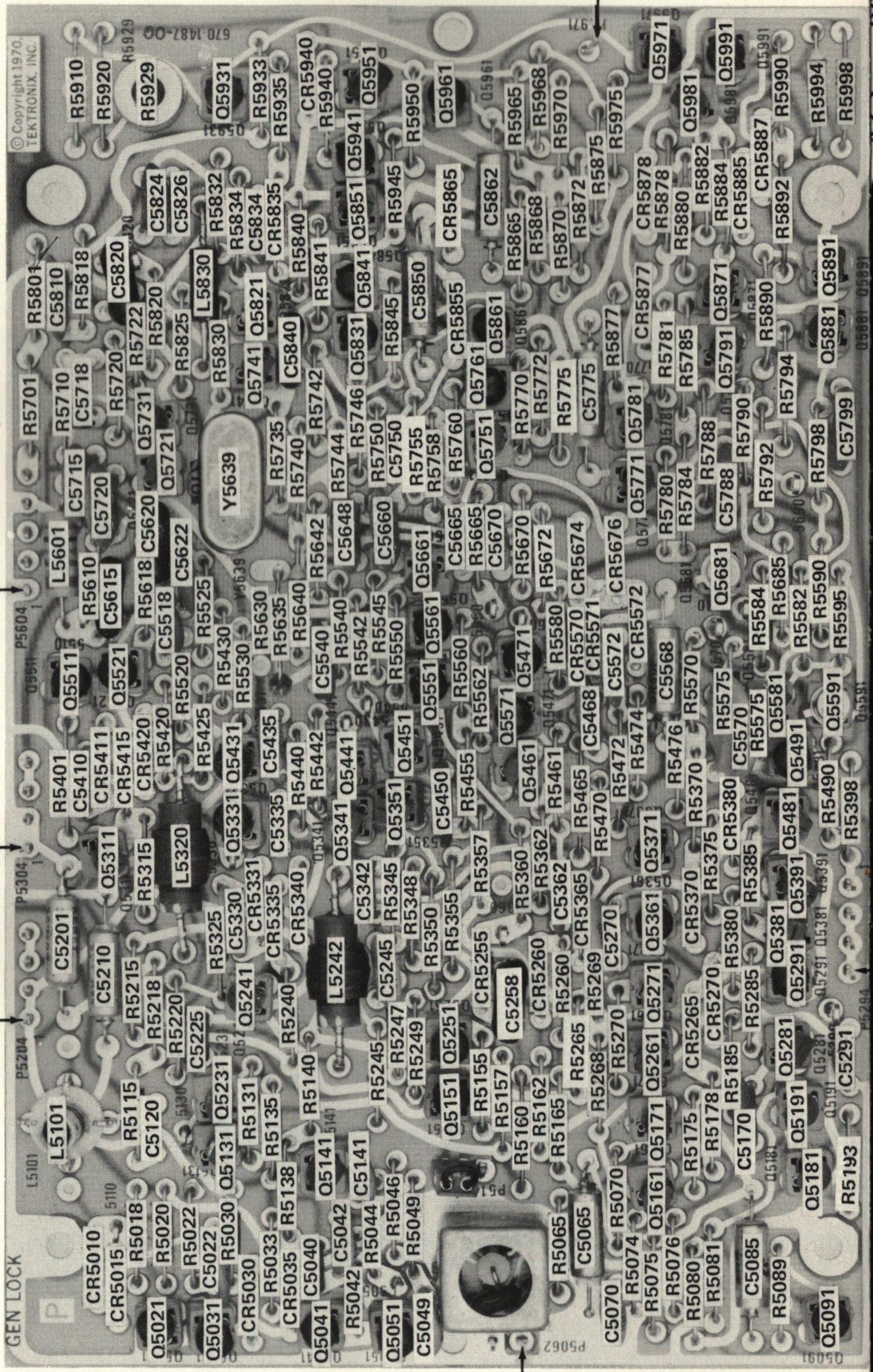


A5 PARTIAL GENLOCK


1
50mV
100nS
0V

Ⓐ

P5971-1 gry on wht



P5604-1 shield for 2
2 blk-grn on wht coax
3
4 shield for 5
5 wht coax

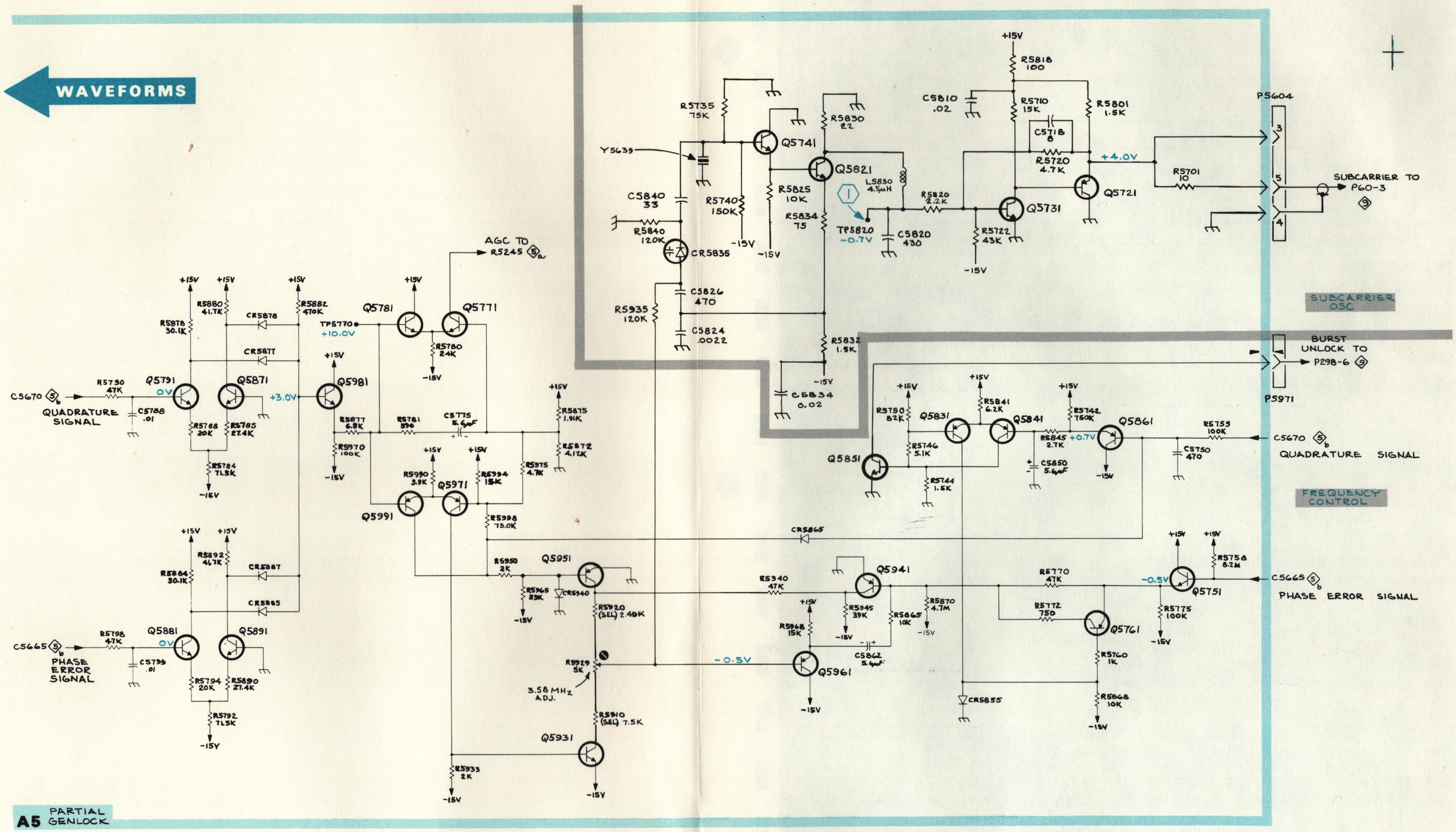
P5304-1
2
3 blk on red
4

P5204-1
2 brn on red
3 blk on vio
4

L5055, C5050, C5048, R5050, R5052, R5055, R5060 — Located in shield CAN

P5062-1 blk-brn on wht coax
2 shield for 1

P5294-1 brn-red on wht
2 red-blu on wht
3 red-blu on wht
4

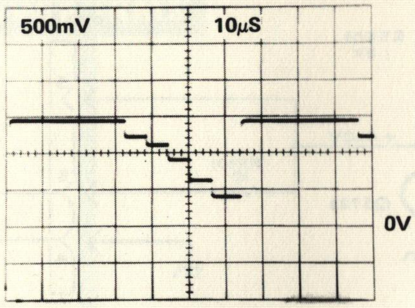


NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES

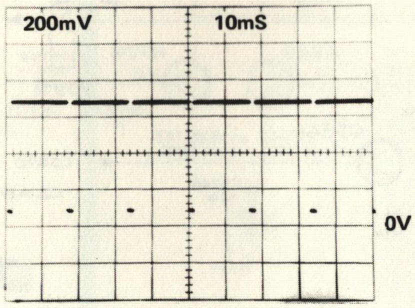
SUBCARRIER OSC & FREQUENCY CONTROL 5c

971 RHL

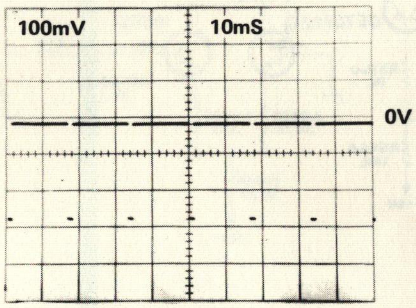
1



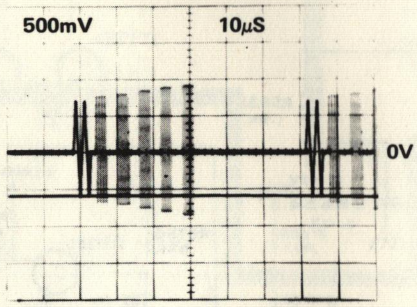
2



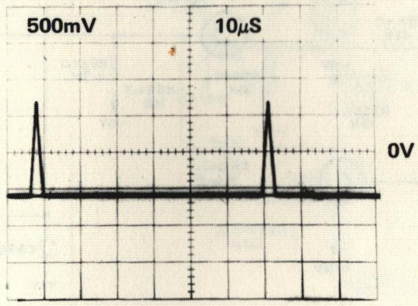
3



4



5



Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page except as follows:

1. Waveform ⟨1⟩ obtained with FULL FIELD SIG Mode switch set to MULTIBURST.

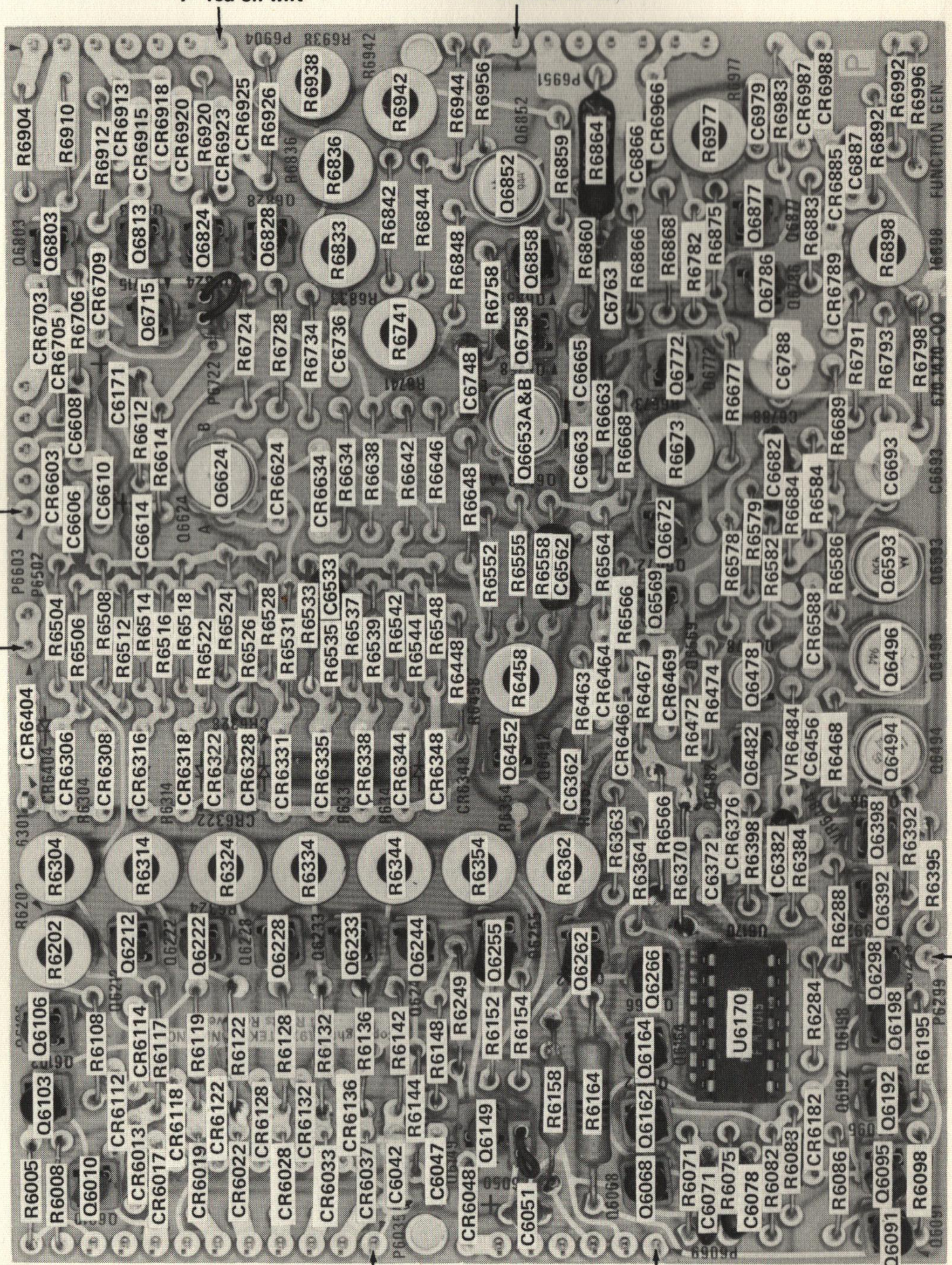
2. Waveform ⟨2⟩ obtained with FULL FIELD SIG Mode switch set to SIN² PULSE & BAR.

P6904-1 brn on wht
2 blk-blu on wht
3 blk-grn on wht
4 blk-orn on wht
5 blk-yel on wht
6 yel on wht
7 red on wht

P6951-1 orn on wht coax
2 shield for 1
3 red on wht coax
4 shield for 3
5 blk
6 brn on wht
7 orn-blu on wht

P6603-1 blk-gry on wht
2 blk-vio on wht
3 blk-blu on wht
4
5 brn-gry on wht

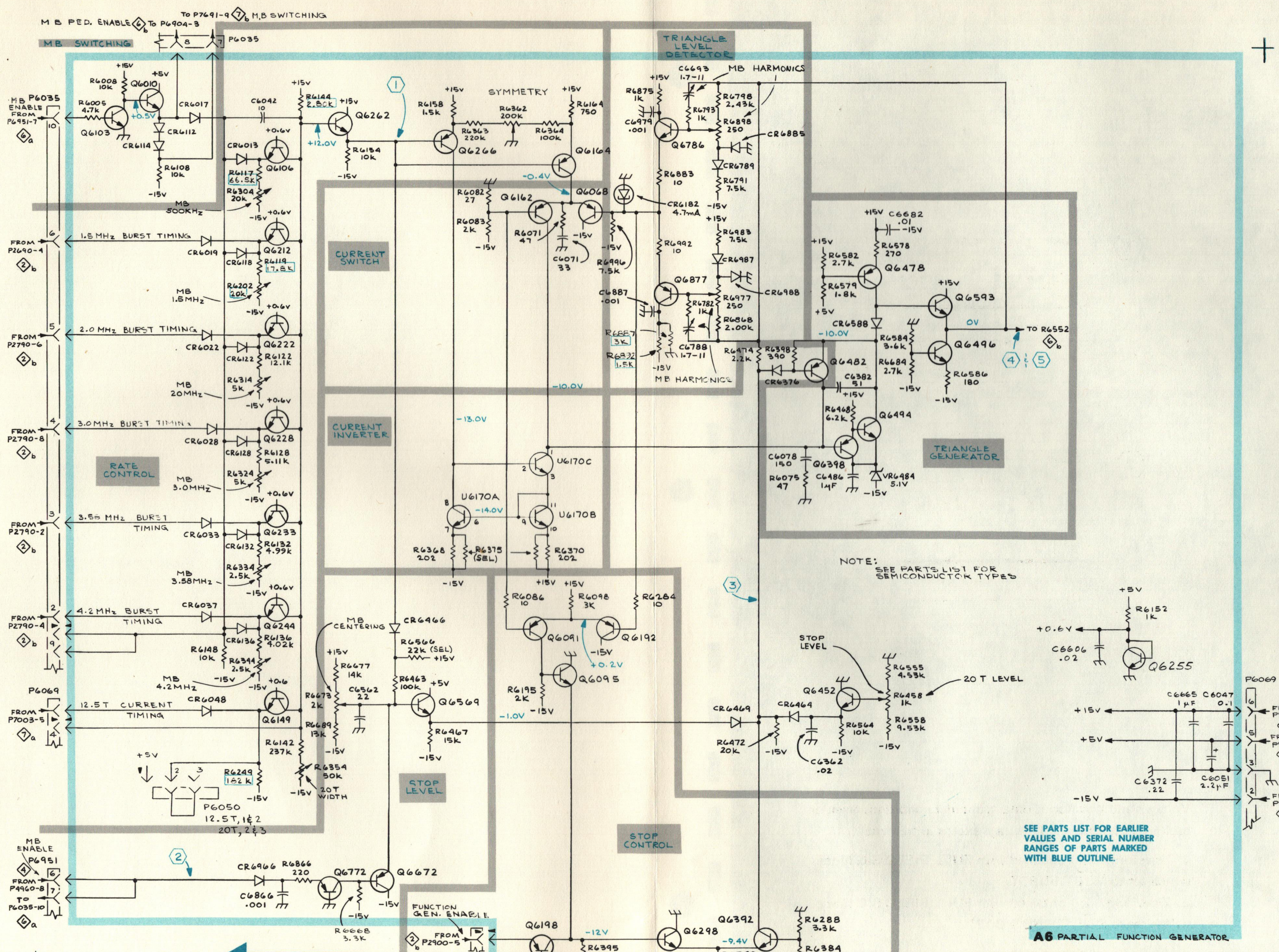
P6502-1 blk
2



P6035-1
2 brn-yel on wht
3 brn-grn on wht
4 brn-red on wht
5 brn-orn on wht
6 blk-gry on wht
7 red-grn on wht
8 blk-grn on wht
9
10 brn on wht

P6069-1 blk on vio
2 blk
3 brn on red
4
5 blk on red
6 orn on wht

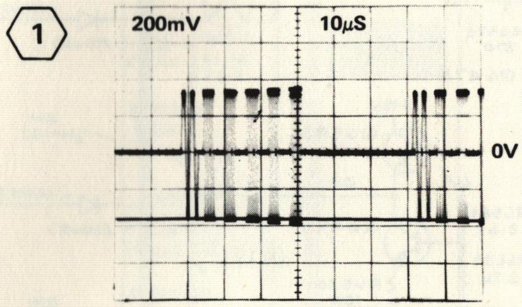
P6299-1 brn on wht

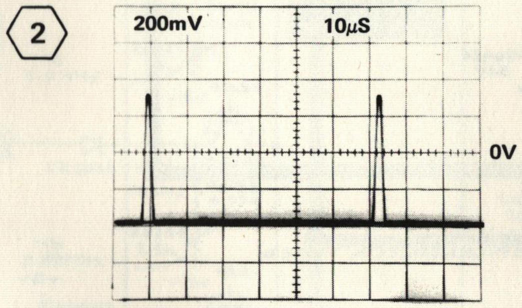


147/R147

WAVEFORMS

FUNCTION GENERATOR ⑥a DEH/RH 1072

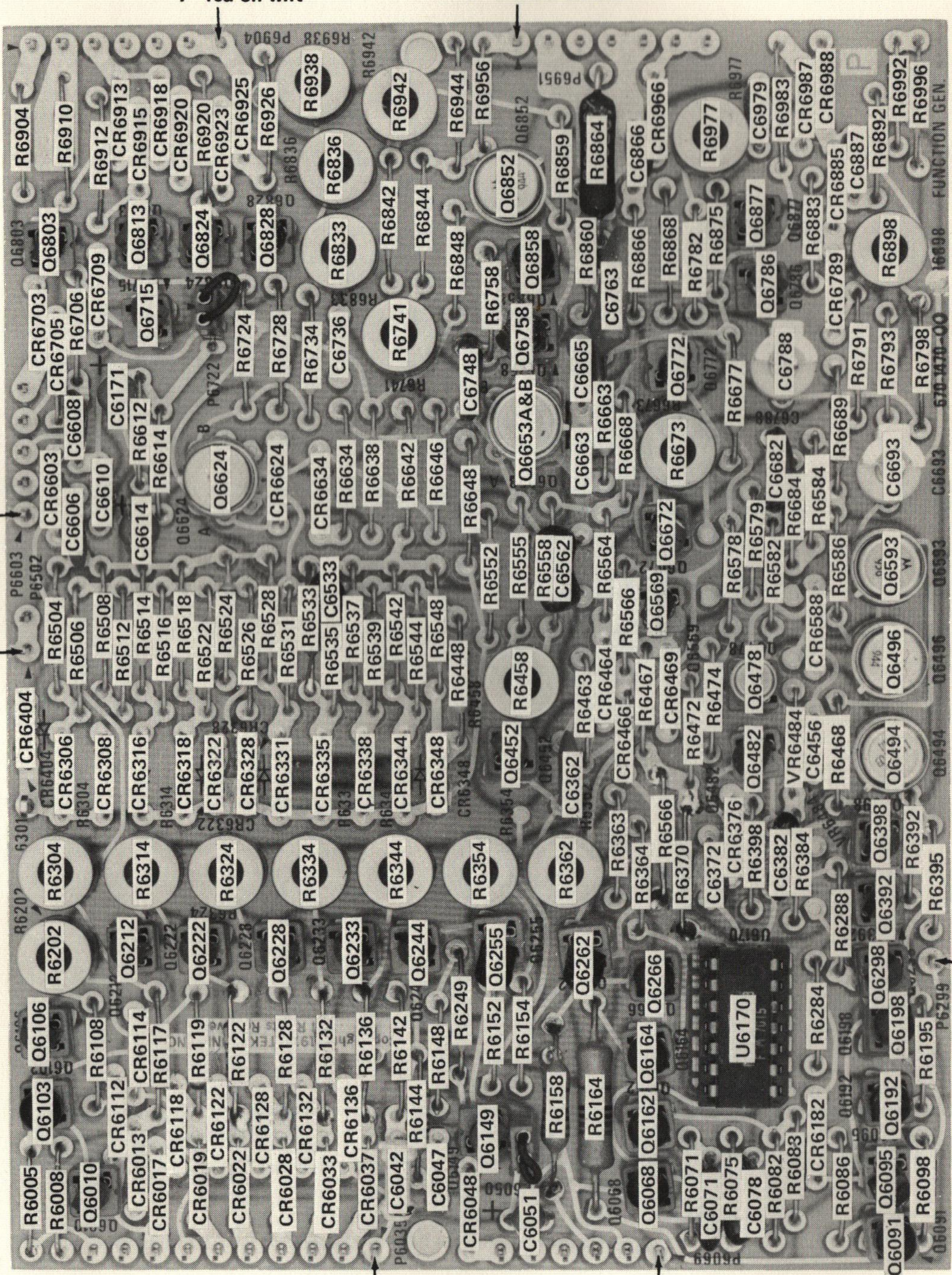


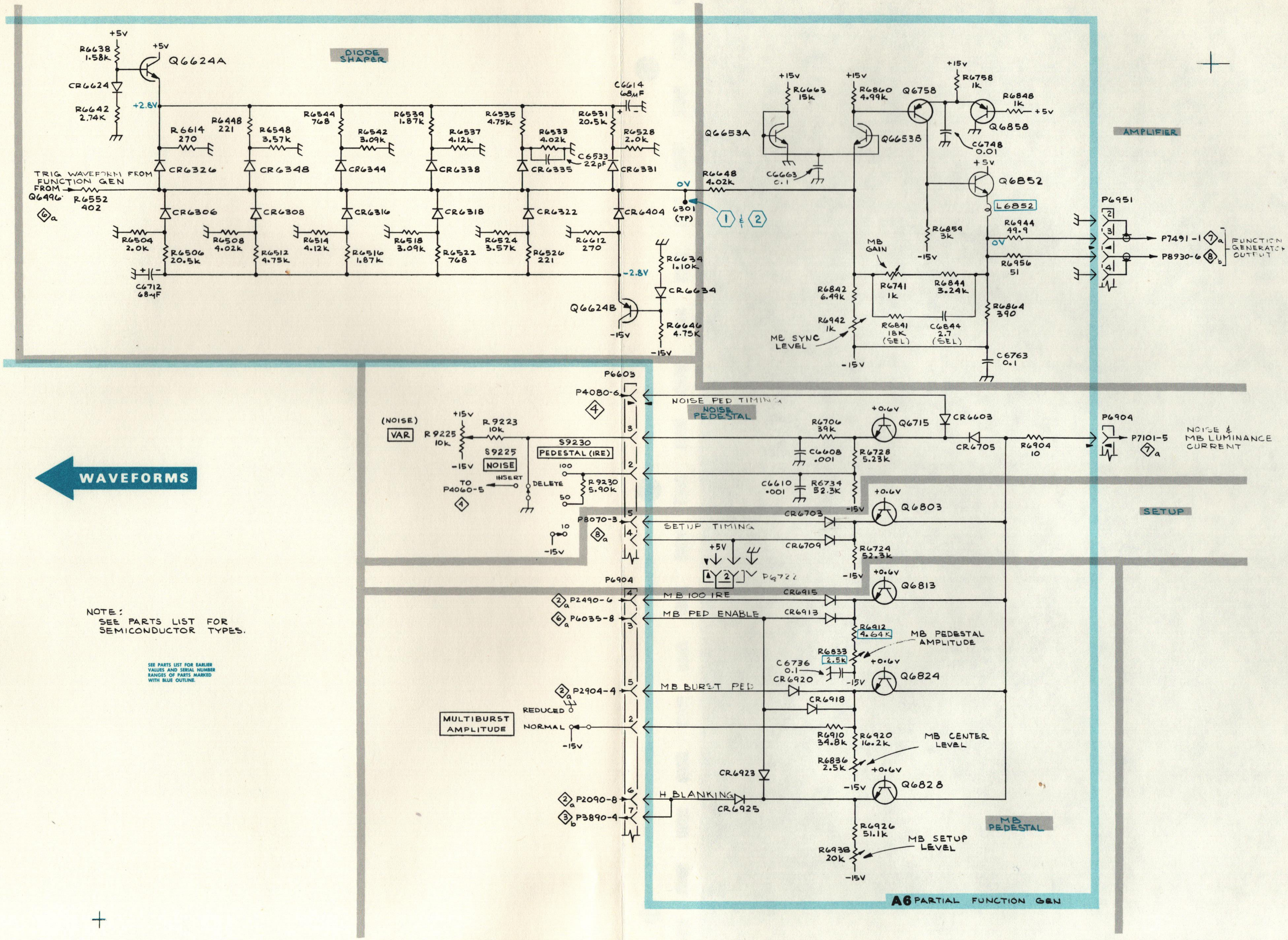


Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page except as follows:

1. Waveform ⟨1⟩ obtained with FULL FIELD SIG Mode switch set to MULTIBURST.

2. Waveform ⟨2⟩ obtained with FULL FIELD SIG Mode switch set to SIN^2 PULSE & BAR.

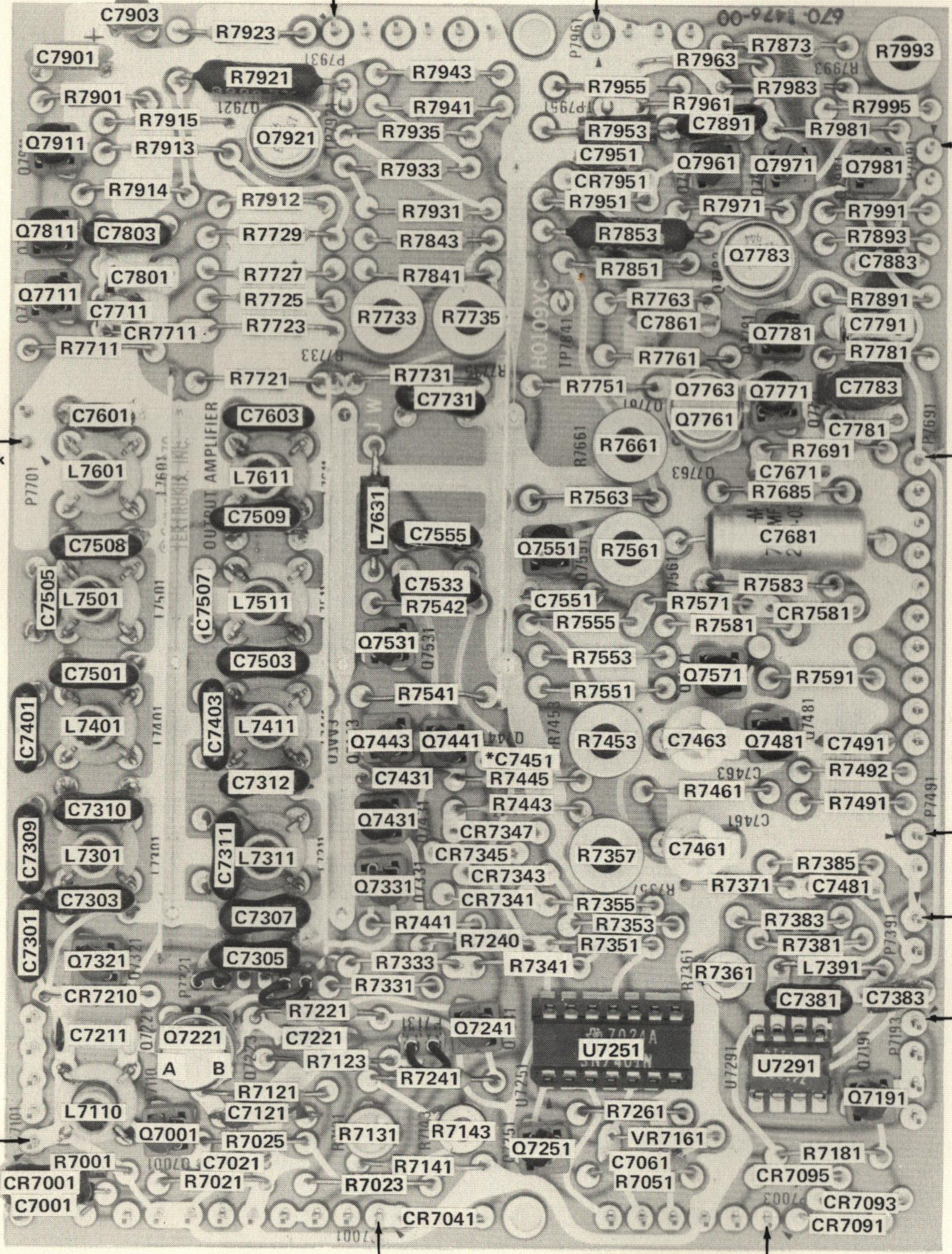

P6904-1 brn on wht
2 blk-blu on wht
3 blk-grn on wht
4 blk-orn on wht
5 blk-yel on wht
6 yel on wht
7 red on wht
P6951-1 orn on wht coax
2 shield for 1
3 red on wht coax
4 shield for 3
5 blk
6 brn on wht
7 orn-blu on wht
P6603-1 blk-gry on wht
2 blk-vio on wht
3 blk-blu on wht
4
5 brn-gry on wht
P6502-1 blk
2
P6035-1
2 brn-yel on wht
3 brn-grn on wht
4 brn-red on wht
5 brn-orn on wht
6 blk-gry on wht
7 red-grn on wht
8 blk-grn on wht
9
10 brn on wht
P6069-1 blk on vio
2 blk
3 brn on red
4
5 blk on red
6 orn on wht
P6299-1 brn on wht
FUNCTION GEN.



NOISE & MULTIBURST PEDESTALS 6b

P7931-1 wht coax
2 shield for 1
3 red on wht coax
4 shield for 3
5 brn on wht coax
6 shield for 5

P7961-1 blk on wht coax
2 shield for 1
3 shield for 4
4 orn on wht coax



P7991-1 grn on wht coax
2 shield for 1

P7701-1
2 blk

P7691-1 brn on red
2 yel on wht
3 orn on wht
4 blk on red
5 shield for 6
6 blk-vio on wht coax
7 brn-yel on wht
8
9 red-grn on wht
10 blk-vio on wht

*Removed SN B060000

P7491-1 orn on wht coax
2 shield for 1

P7391-1 shield for 2
2 grn on wht coax

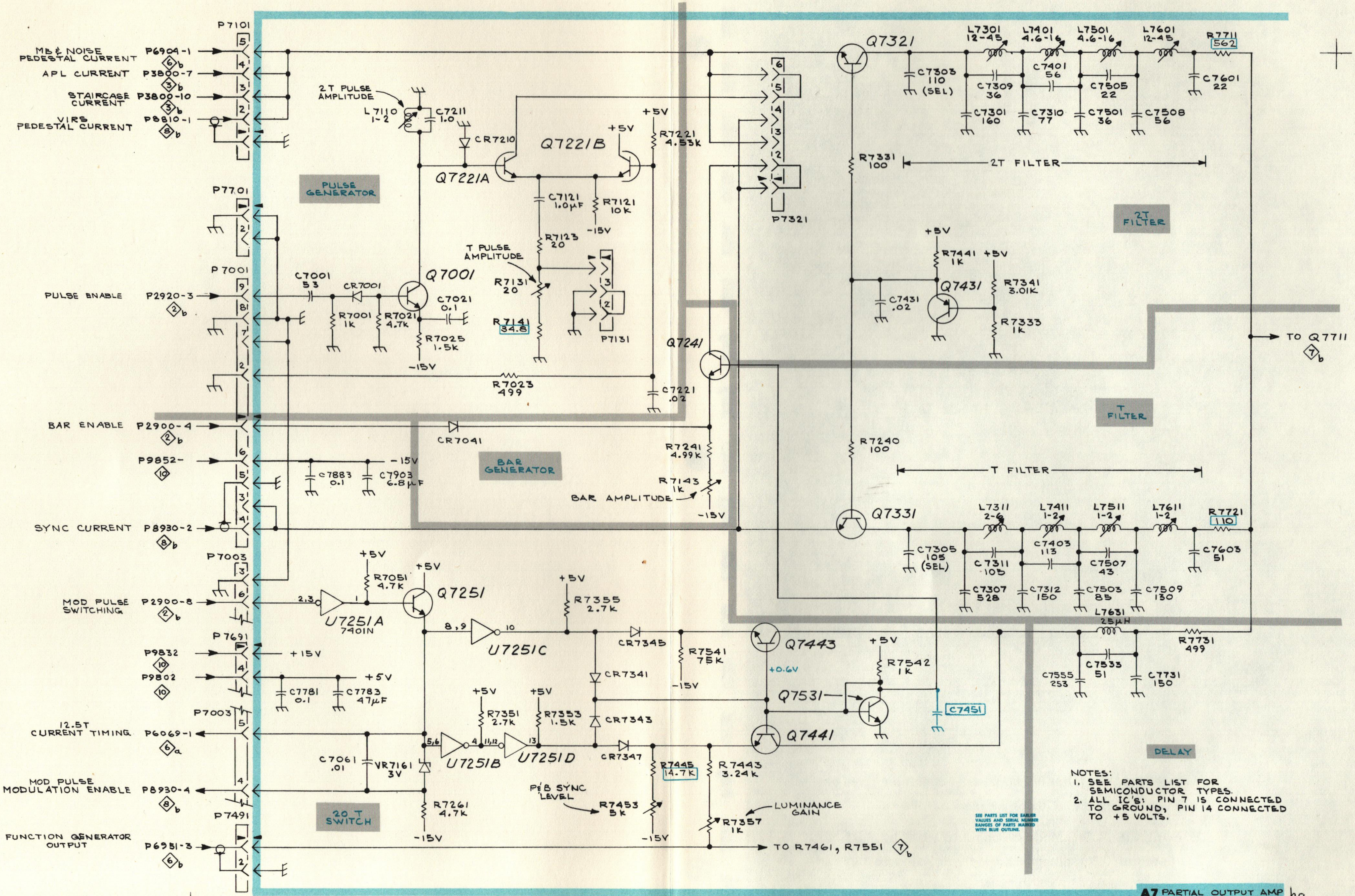
P7193-1 shield for 2
2 brn on wht coax
3 yel on wht coax
4 shield for 3

P7101-1 shield for 2
2 blk-brn on wht coax
3 red on wht
4 grn on wht
5 brn on wht

P7001-1 orn-yel on wht
2 blk
3
4 blk-gry on wht coax
5 shield for 4
6 blk on vio
7
8 blk
9 red-grn on wht

P7003-1 orn-vio on wht
2 orn-blu on wht
3 blk
4 orn-yel on wht
5 orn on wht
6 red-blu on wht

FILTERS

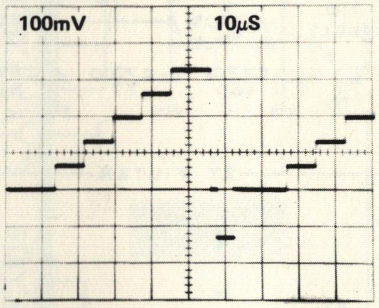


A7 PARTIAL OUTPUT AMP

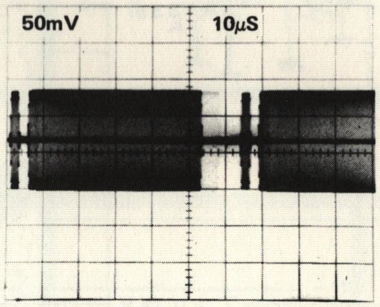
REV. JAN. 1974

FILTERS 7a

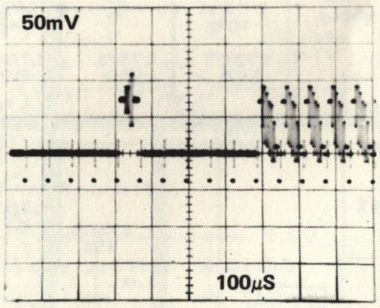
1



2



3

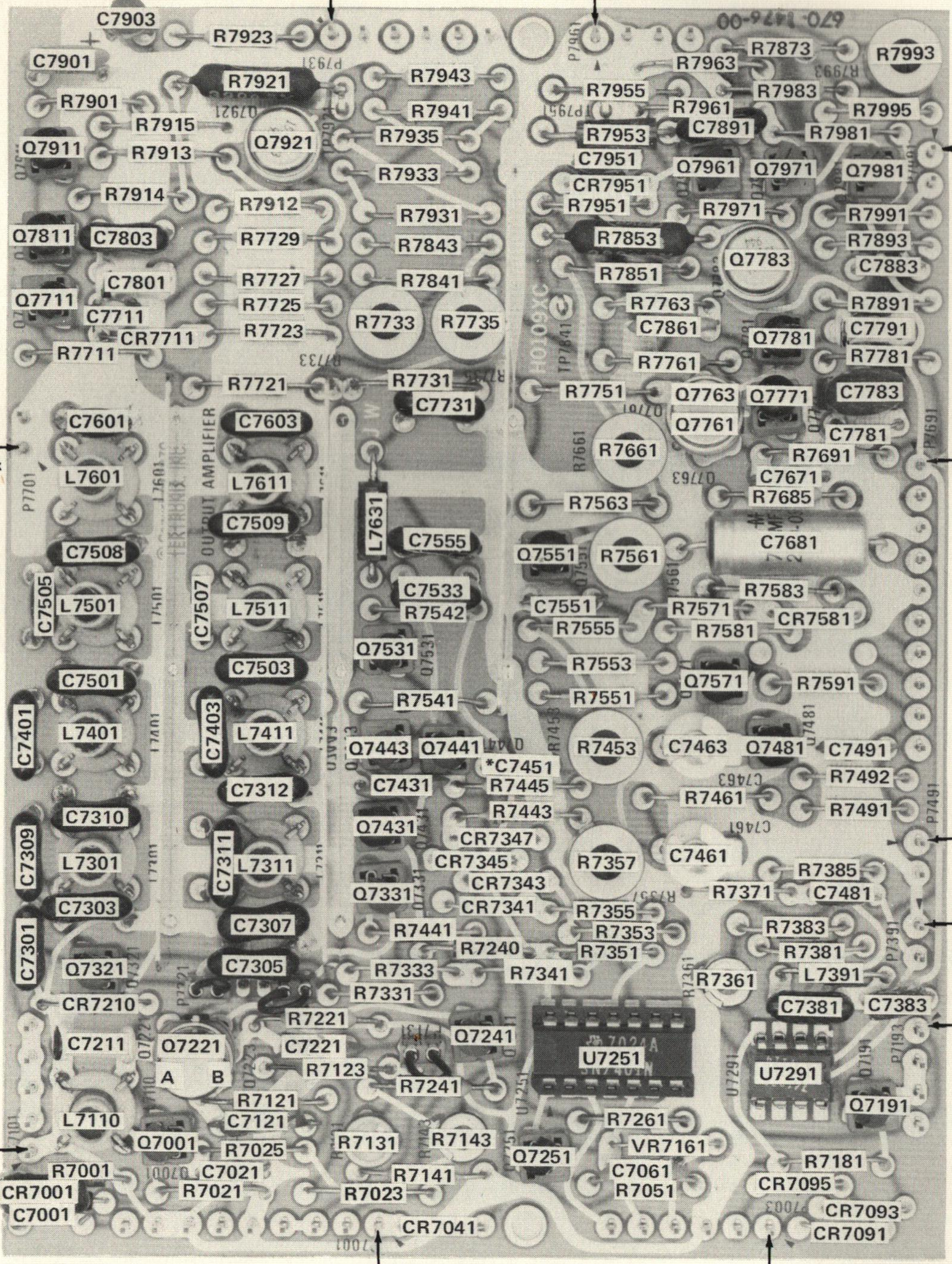


Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page except as follows:

1. FULL FIELD SIG Mode switch set to MULTIBURST.
2. Waveform ⟨3⟩ obtained by applying an external VIT to the 147 rear-panel EXT VITS IN connector.

P7931-1 wht coax
2 shield for 1
3 red on wht coax
4 shield for 3
5 brn on wht coax
6 shield for 5

P7961-1 blk on wht coax
2 shield for 1
3 shield for 4
4 orn on wht coax



P7991-1 grn on wht coax
2 shield for 1

P7701-1
2 blk

P7691-1 brn on red
2 yel on wht
3 orn on wht
4 blk on red
5 shield for 6
6 blk-vio on wht coax
7 brn-yel on wht
8
9 red-grn on wht
10 blk-vio on wht

*Removed SN B060000

P7491-1 orn on wht coax
2 shield for 1

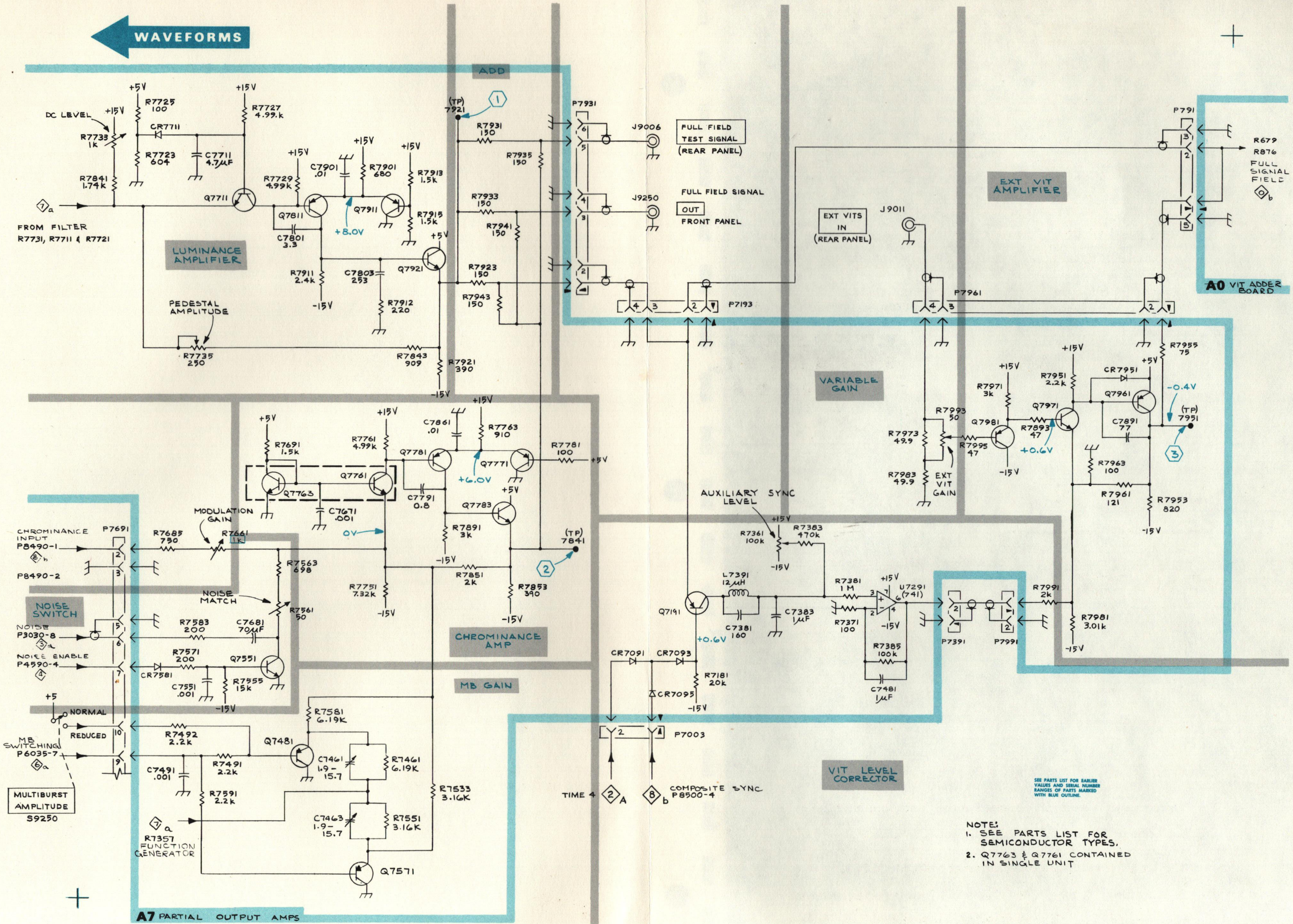
P7391-1 shield for 2
2 grn on wht coax

P7193-1 shield for 2
2 brn on wht coax
3 yel on wht coax
4 shield for 3

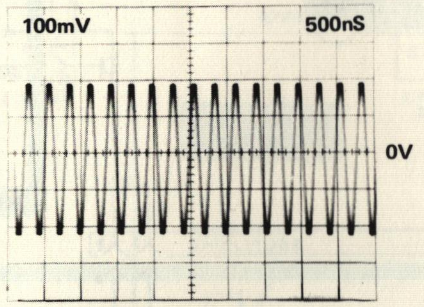
P7101-1 shield for 2
2 blk-brn on wht coax
3 red on wht
4 grn on wht
5 brn on wht

P7001-1 orn-yel on wht
2 blk
3
4 blk-gry on wht coax
5 shield for 4
6 blk on vio
7
8 blk
9 red-grn on wht

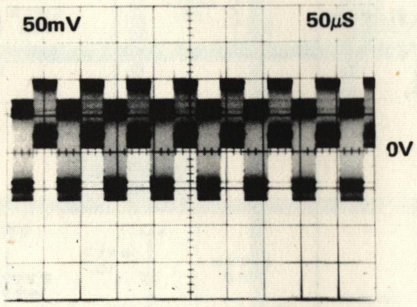
P7003-1 orn-vio on wht
2 orn-blu on wht
3 blk
4 orn-yel on wht
5 orn on wht
6 red-blu on wht


WAVEFORMS
ADD
LUMINANCE AMPLIFIER
DC LEVEL
R7733 1k
R7725 100
R7727 4.99k
CR7711
R7723 604
C7711 4.7µF
R7841 1.74k
Q7711
FROM FILTER R7731, R7711 & R7721
Q7811
C7901 .01
R7901 680
R7729 4.99k
Q7911
R7913 1.5k
R7915 1.5k
C7801 3.3
+8.0V
Q7921
R7911 2.4k
C7803 253
R7912 220
PEDESTAL AMPLITUDE
R7735 250
R7843 909
R7921 390
(TP) 7921
R7931 150
R7935 150
R7933 150
R7941 150
R7923 150
R7943 150
P7931
J9006
FULL FIELD TEST SIGNAL (REAR PANEL)
FULL FIELD SIGNAL
J9250
OUT
FRONT PANEL
P7193
EXT VITS IN (REAR PANEL)
J9011
EXT VIT AMPLIFIER
P791
R679
R876
FULL SIGNAL FIELD
A0 VIT ADDER BOARD
P7961
VARIABLE GAIN
R7955 75
CR7951
Q7961
R7951 2.2k
R7971 3k
Q7971
Q7981
R7993 50
R7973 49.9
R7995 47
R7893 47
+0.6V
-0.4V
(TP) 7951
C7891 77
R7983 49.9
EXT VIT GAIN
R7963 100
R7961 121
R7953 820
R7691 1.5k
R7761 4.99k
C7861 .01
R7763 910
Q7781
Q7771
R7781 100
Q7761
Q7763
C7791 0.8
+6.0V
C7671 .001
Q7783
MODULATION GAIN
0V
R7891 3k
(TP) 7841
CHROMINANCE INPUT P8490-1
P8490-2
P7691
R7685 750
R7661 1k
R7563 698
R7851 2k
R7751 7.32k
R7853 390
NOISE SWITCH
NOISE P3030-8
NOISE MATCH
R7561 50
R7583 200
C7681 70µF
CHROMINANCE AMP
NOISE ENABLE P4590-4
R7571 200
CR7581
Q7551
C7551 .001
R7555 15k
MB GAIN
NORMAL
REDUCED
MB SWITCHING P6035-7
R7492 2.2k
R7491 2.2k
C7491 .001
R7581 6.19k
Q7481
C7461 1.9-15.7
R7461 6.19k
R7533 3.16K
R7591 2.2k
C7463 1.9-15.7
R7551 3.16K
MULTIBURST AMPLITUDE S9250
R7357 FUNCTION GENERATOR
Q7571
A7 PARTIAL OUTPUT AMPS
AUXILIARY SYNC LEVEL
R7361 100k
R7383 470k
L7391 12µH
Q7191
C7381 160
C7383 1µF
R7381 1M
R7371 100
U7291 (741)
R7385 100k
C7481 1µF
+0.6V
CR7091
CR7093
CR7095
R7181 20k
P7391
P7991
R7991 2k
R7981 3.01k
P7003
TIME 4
COMPOSITE SYNC P8500-4
VIT LEVEL CORRECTOR
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
NOTE:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
2. Q7763 & Q7761 CONTAINED IN SINGLE UNIT

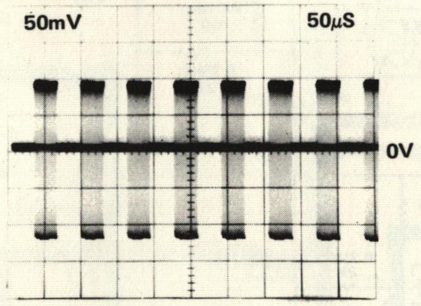
1



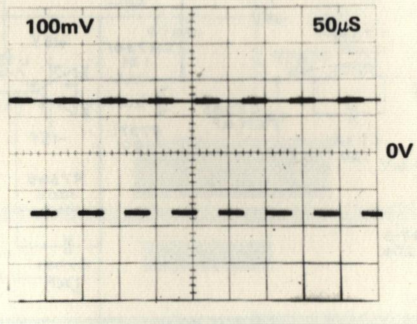
3



2



4



Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page except as follows:

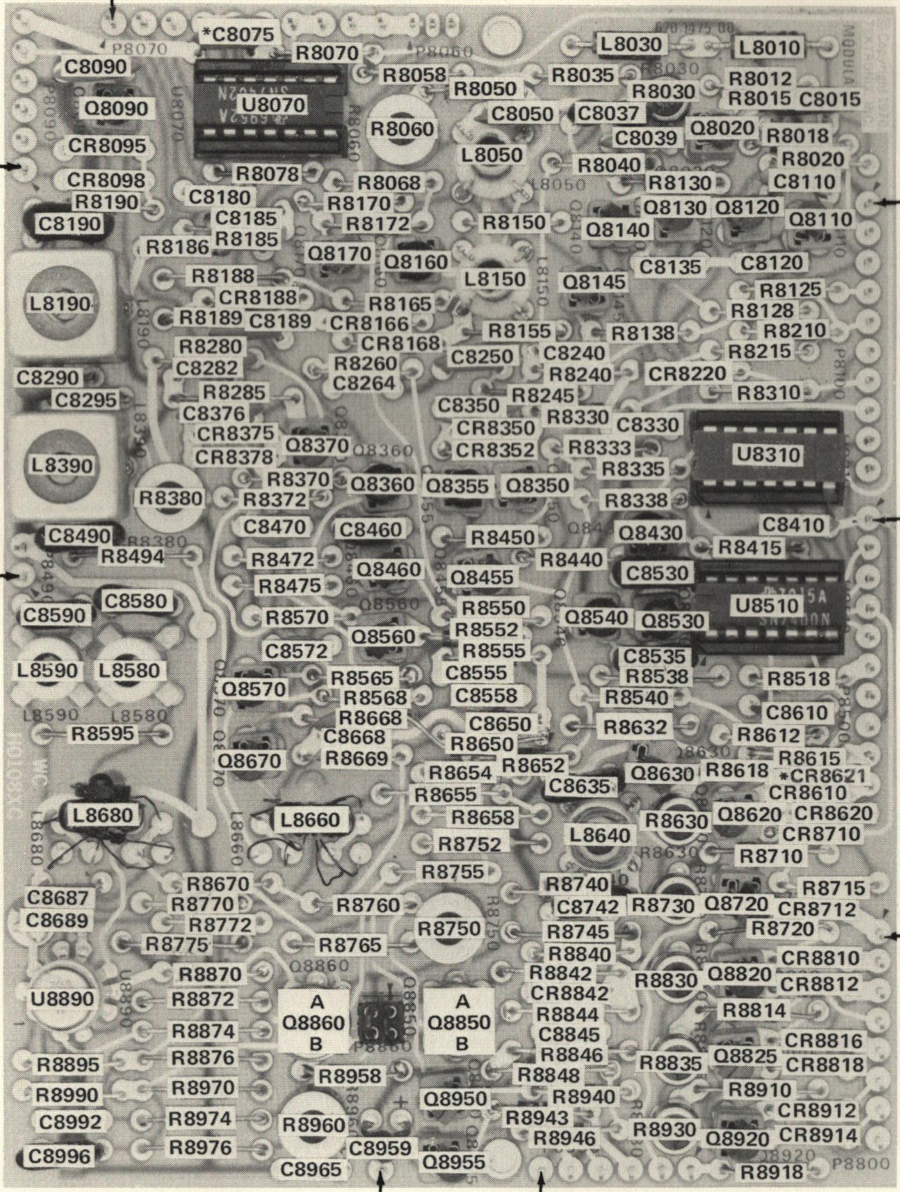
1. **FULL FIELD SIG Mode switch set to COMPOSITE.**
2. **Waveforms ⟨1⟩, ⟨2⟩, and ⟨3⟩ obtained by externally triggering from the 147 CW SUBCARRIER OUT.**

P8070-1 blk-yel on wht coax
2 red on wht
3 brn-gry on wht
4 red-vio on wht
5 red-vio on wht
6 blk-vio on wht
7 yel on wht
8 yel on wht
9 orn on wht
10 orn on wht

*Removed SN B060000

P8090
1 blu on wht
2 grn-blu on wht
3 grn-blu on wht
4
5
6 blk

P8490
1 yel on wht
2 orn on wht



P8100
1 shield for 2
2 blk-grn on wht coax
3 red-grn on wht
4 brn on red
5 blk on vio
6 red-gry on wht
7 red-blu on wht
8 brn-red on wht
9 yel on wht
10 blk-brn on wht

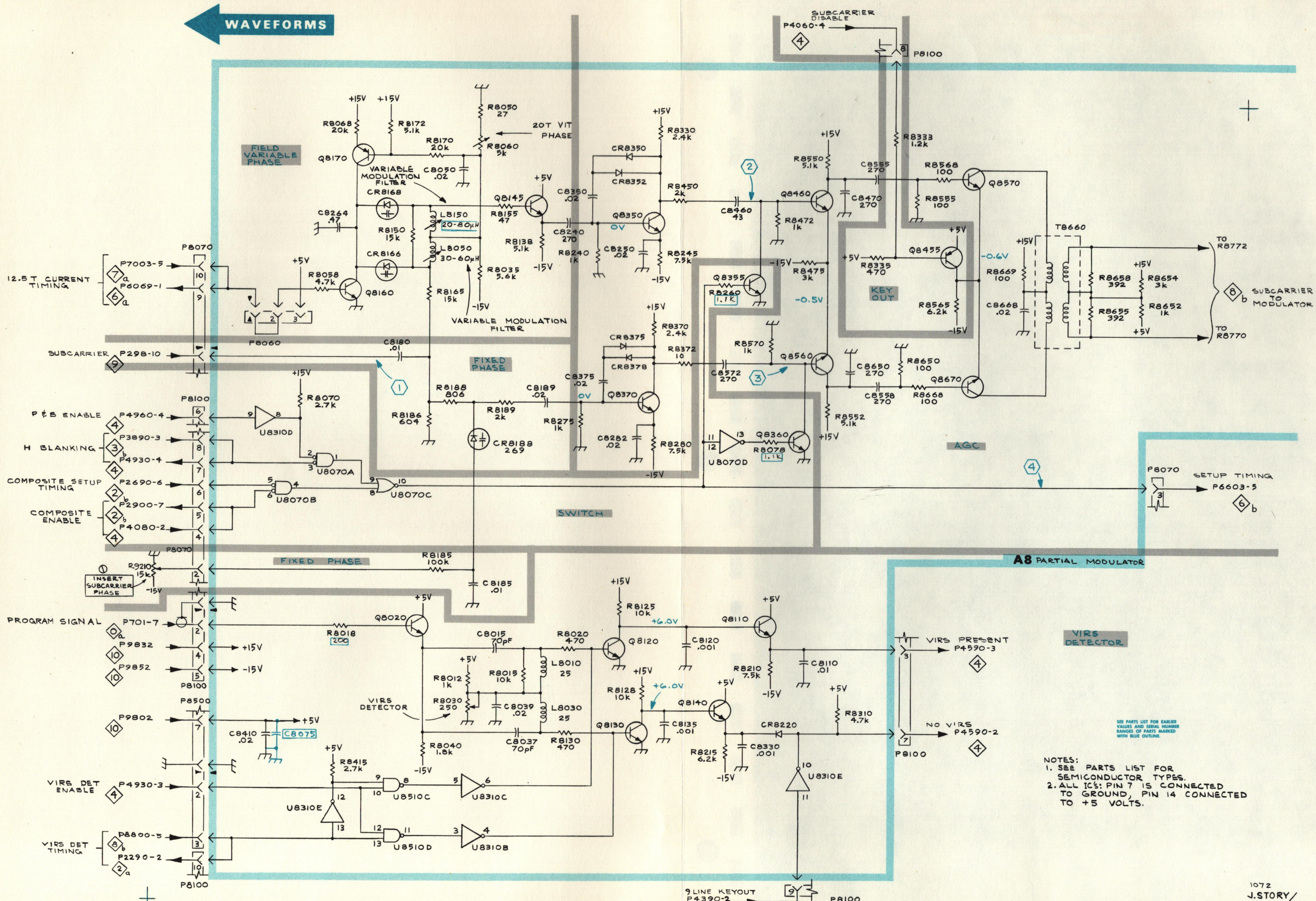
P8500
1 blk
2 blk-red on wht
3 blk-orn on wht
4 orn-vio on wht
5 orn on wht
6 blu on wht
7 blk on red
8
9 vio on wht coax
10

P8800
1
2 yel on wht
3
4
5 blk-orn on wht
6 grn-blu on wht
7 blk on wht
8

*See Parts List for serial number ranges.

P8960-1 blk

P8930-1 blk-brn on wht coax
2 blk-gry on wht coax
3 shield for 2
4 orn-yel on wht
5 shield for 6
6 red on wht coax



1072
J.STORY/RL

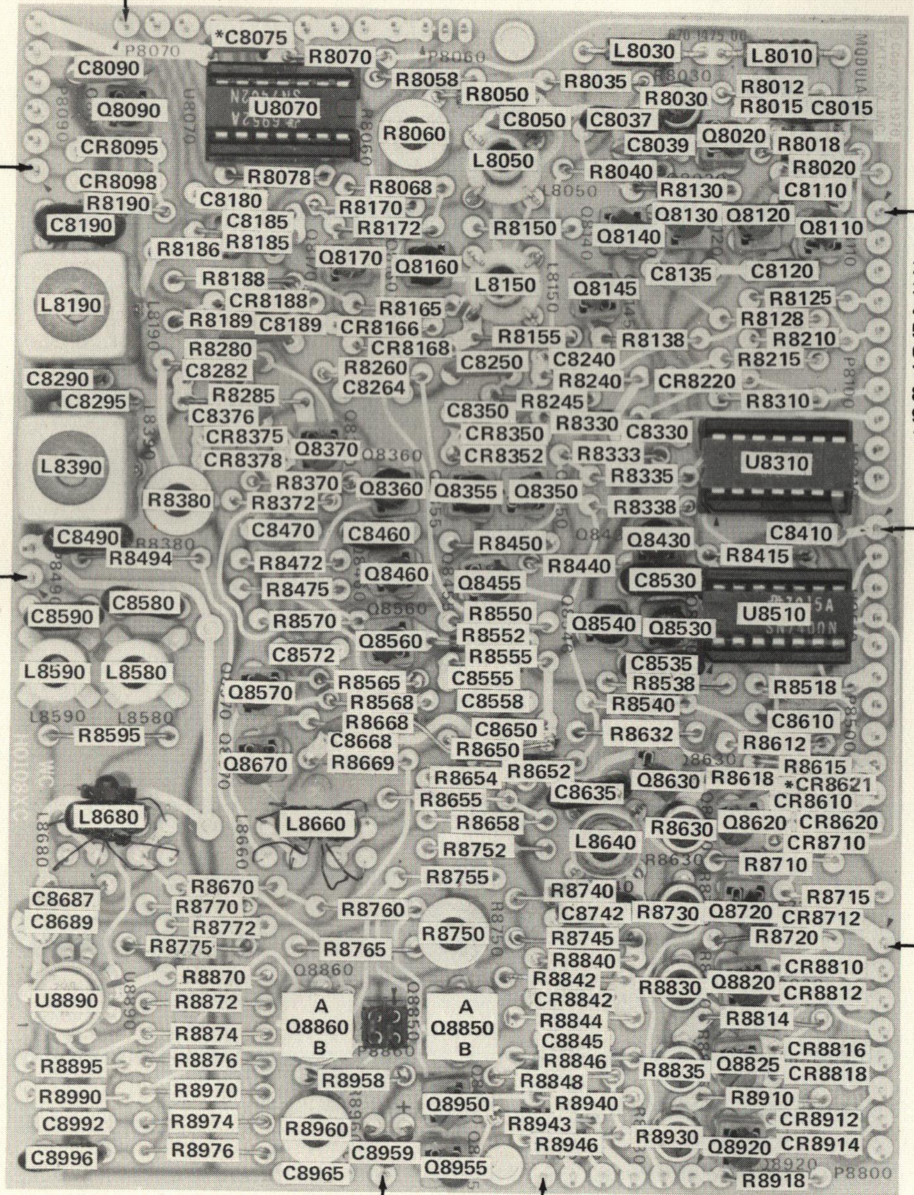
VIRS DETECTOR & CW PHASE SHIFTER 8a

P8070-1 blk-yel on wht coax
2 red on wht
3 brn-gry on wht
4 red-vio on wht
5 red-vio on wht
6 blk-vio on wht
7 yel on wht
8 yel on wht
9 orn on wht
10 orn on wht

*Removed SN B060000

P8090
1 blu on wht
2 grn-blu on wht
3 grn-blu on wht
4
5
6 blk

P8490
1 yel on wht
2 orn on wht



P8100
1 shield for 2
2 blk-grn on wht coax
3 red-grn on wht
4 brn on red
5 blk on vio
6 red-gry on wht
7 red-blu on wht
8 brn-red on wht
9 yel on wht
10 blk-brn on wht

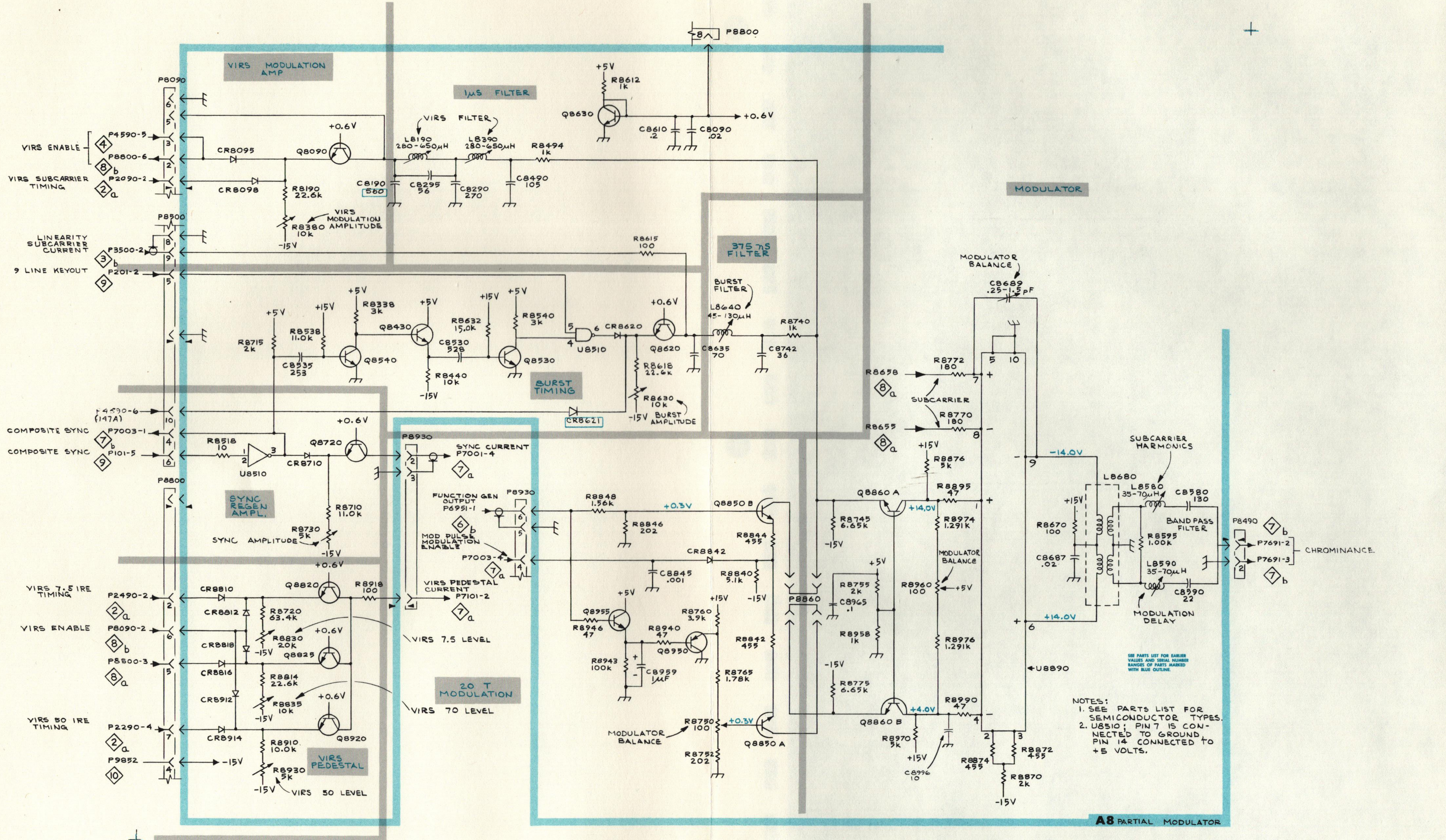
P8500
1 blk
2 blk-red on wht
3 blk-orn on wht
4 orn-vio on wht
5 orn on wht
6 blu on wht
7 blk on red
8
9 vio on wht coax
10

P8800
1
2 yel on wht
3
4
5 blk-orn on wht
6 grn-blu on wht
7 blk on wht
8

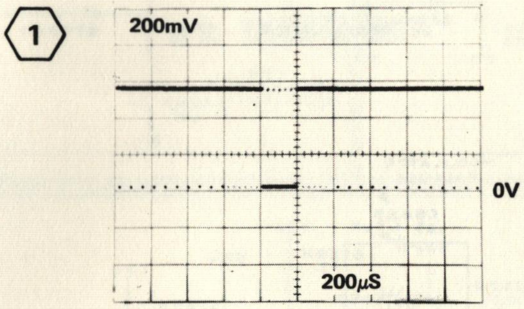
*See Parts List for serial number ranges.

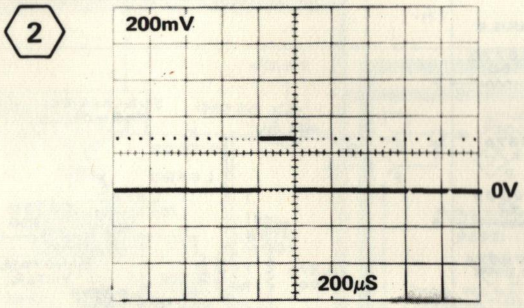
P8960-1 blk

P8930-1 blk-brn on wht coax
2 blk-gry on wht coax
3 shield for 2
4 orn-yel on wht
5 shield for 6
6 red on wht coax


VIRS MODULATION AMP
1μS FILTER
VIRS FILTER
MODULATOR
375 nS FILTER
BURST FILTER
MODULATOR BALANCE
BURST TIMING
BURST AMPLITUDE
SYNC REGEN AMPL.
20 T MODULATION
VIRS PEDESTAL
VIRS ENABLE
VIRS SUBCARRIER TIMING
LINEARITY SUBCARRIER CURRENT
9 LINE KEYOUT
COMPOSITE SYNC
SYNC AMPLITUDE
SYNC CURRENT
FUNCTION GEN OUTPUT
MOD PULSE MODULATION ENABLE
VIRS PEDESTAL CURRENT
VIRS 7.5 IRE TIMING
VIRS 50 IRE TIMING
VIRS 7.5 LEVEL
VIRS 70 LEVEL
VIRS 50 LEVEL
VIRS MODULATION AMPLITUDE
SUBCARRIER
SUBCARRIER HARMONICS
BAND PASS FILTER
MODULATION DELAY
CHROMINANCE
U8890
SEE PARTS LIST FOR EARLIER VALUES AND SERIAL NUMBER RANGES OF PARTS MARKED WITH BLUE OUTLINE.
NOTES:
1. SEE PARTS LIST FOR SEMICONDUCTOR TYPES.
2. U8510; PIN 7 IS CONNECTED TO GROUND. PIN 14 CONNECTED TO +5 VOLTS.
A8 PARTIAL MODULATOR

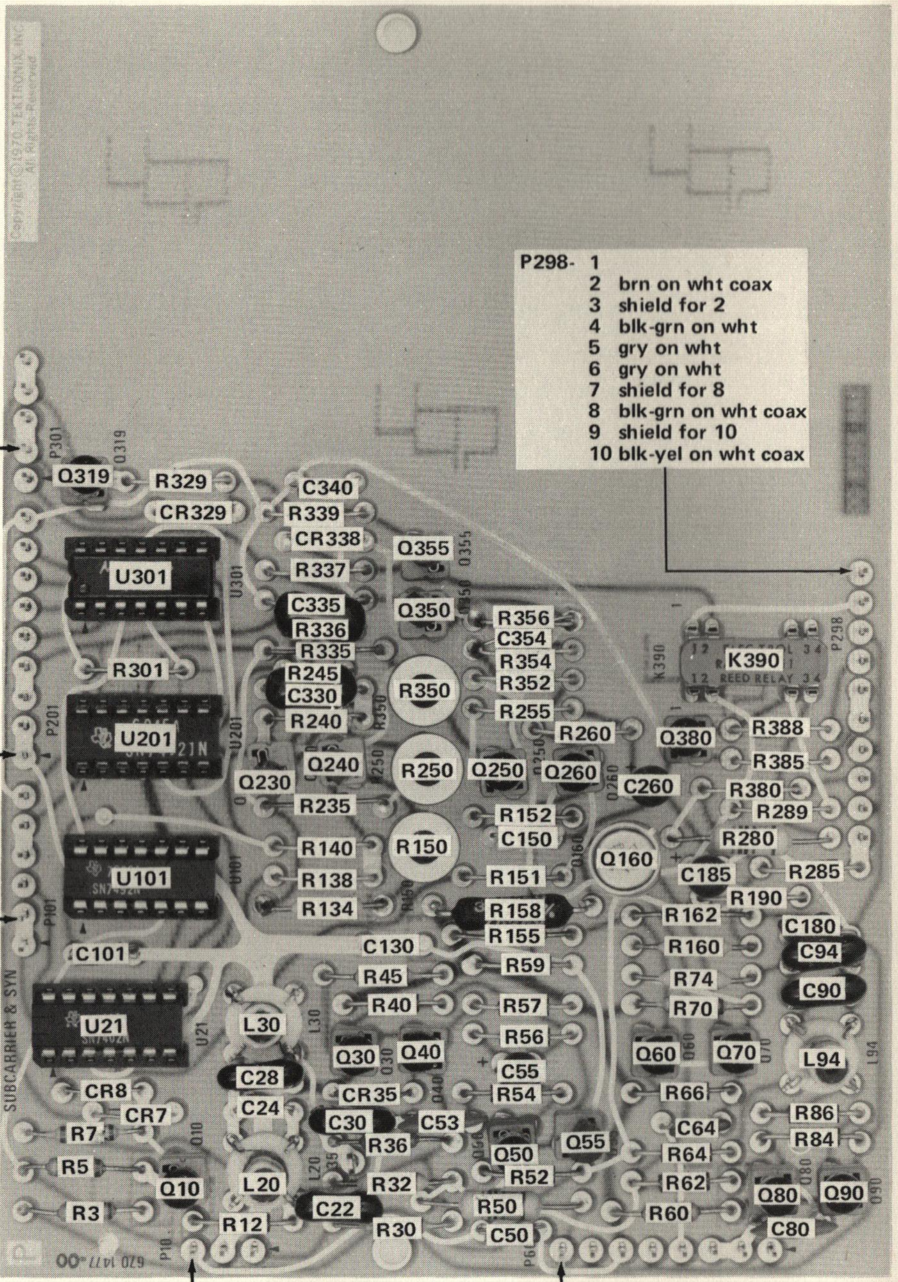
MODULATOR





Voltages and Waveforms obtained under conditions given on back side of Section 7 Title page except as follows:

1. Waveforms obtained using delayed sweep.



P298-
1
2 brn on wht coax
3 shield for 2
4 blk-grn on wht
5 gry on wht
6 gry on wht
7 shield for 8
8 blk-grn on wht coax
9 shield for 10
10 blk-yel on wht coax

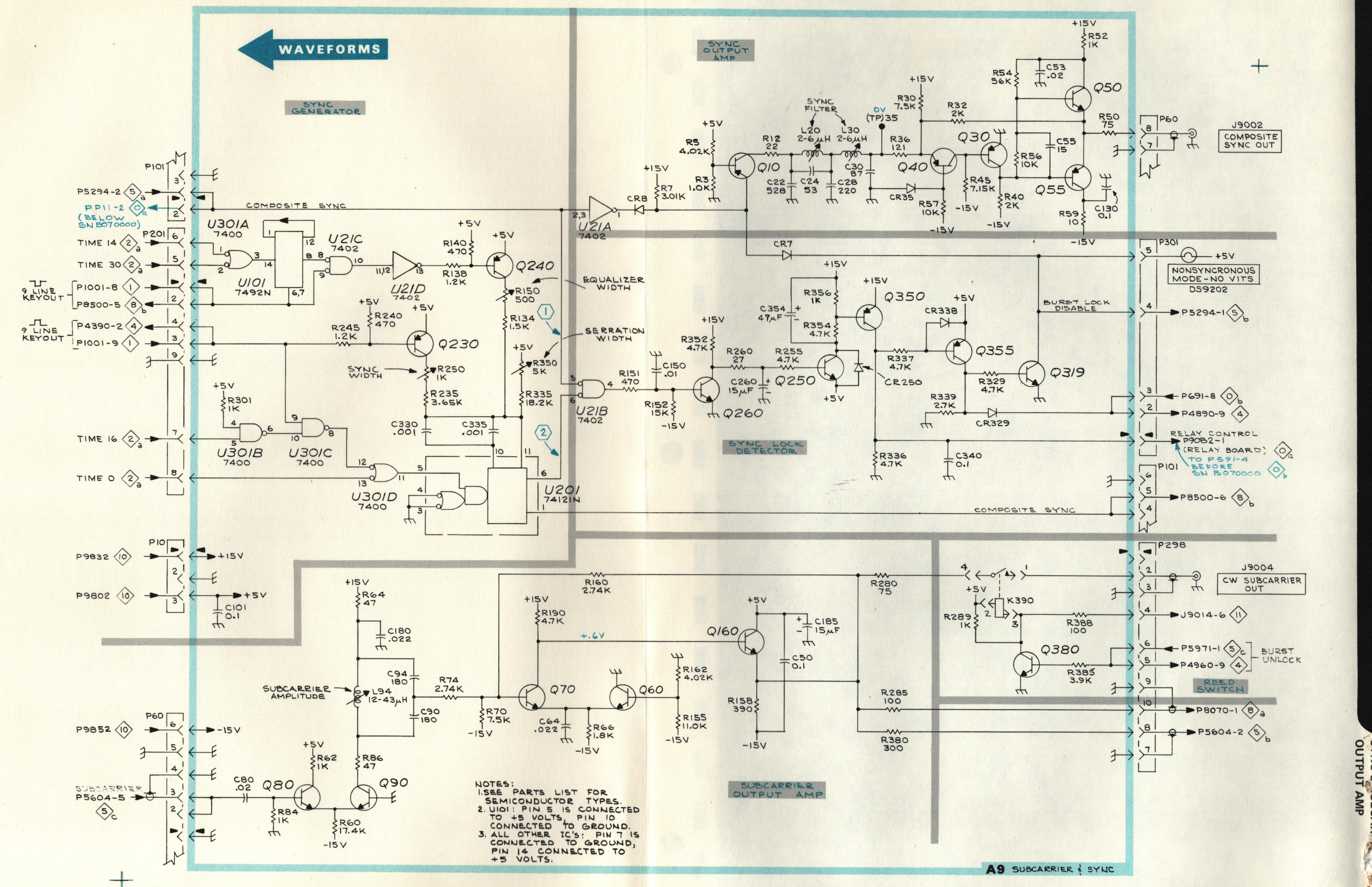
P301-
1 grn-blu on wht
2 blk-blu on wht
3 blk-blu on wht
4 brn-red on wht
5 brn

P201-
1 orn on wht
2 orn on wht
3 yel on wht
4 yel on wht
5 blk-blu on wht
6 blk-yel on wht
7 blk-grn on wht
8 blk-vio on wht
9 blk

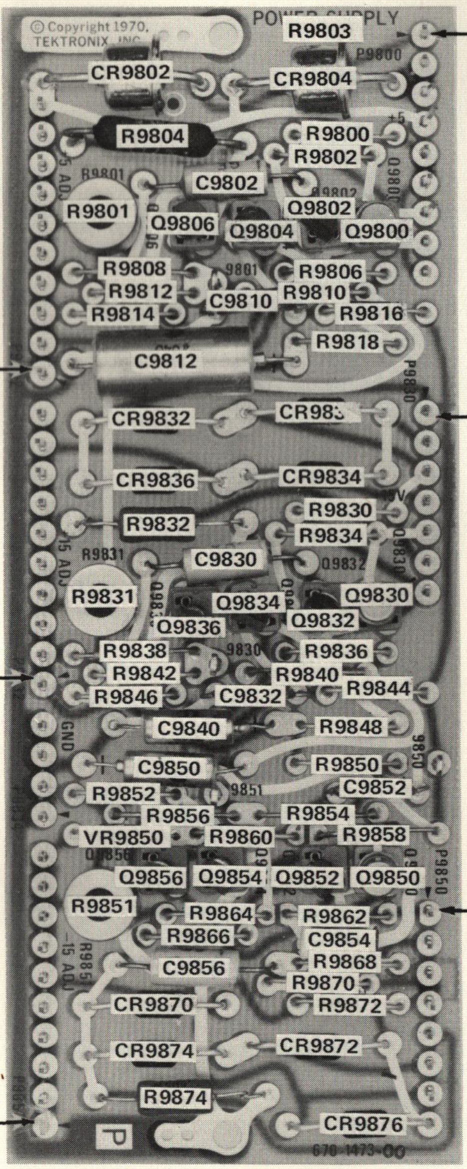
P101-
1 red-blu on wht
2 red-blu on wht
3
4
5 blu on wht
6

P10-
1 brn on red
2 blk
3 blk on red

P60-
1
2
3 wht coax
4 shield for 3
5
6 blk on vio
7 shield for 8
8 blu on wht coax



SYNC & SUBCARRIER OUTPUT AMPLIFIERS ⑨



P9800-1	blk-blu on wht
2	brn-red on wht
3	yel on brn
4	blk on red
5	orn on brn
6	blk-vio on gry
7	blk on wht
8	yel on wht
9	grn on wht

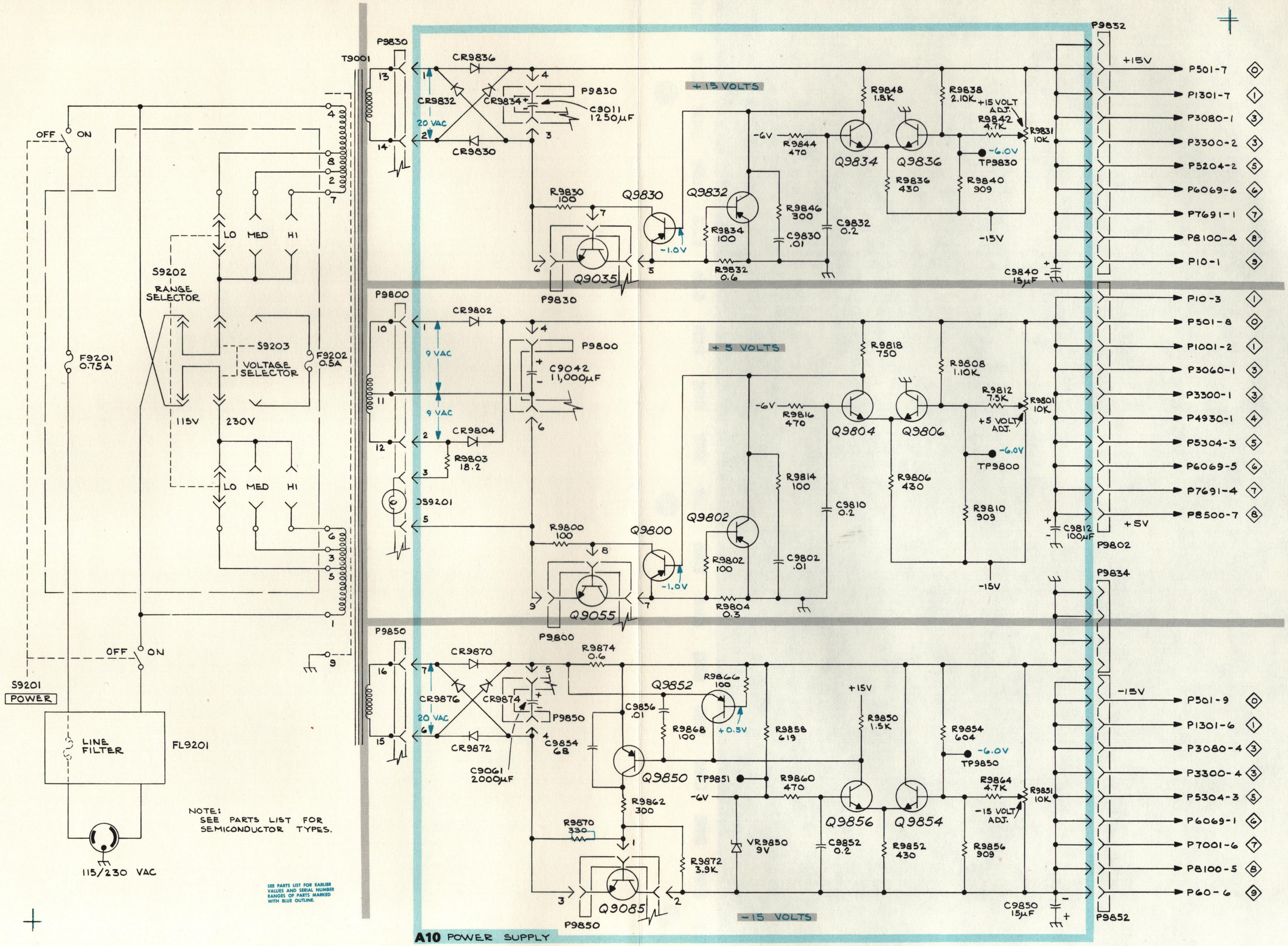
P9802-1	blk on red
2	blk on red
3	blk on red
4	blk on red
5	blk on red
6	blk on red
7	blk on red
8	blk on red
9	blk on red
10	blk on red

P9830-1	brn-orn on gry
2	brn-yel on gry
3	orn on wht
4	brn on red
5	red on wht
6	orn on wht
7	vio on wht

P9832-1	brn on red
2	brn on red
3	brn on red
4	brn on red
5	brn on red
6	
7	brn on red
8	brn on red
9	brn on red
10	brn on red

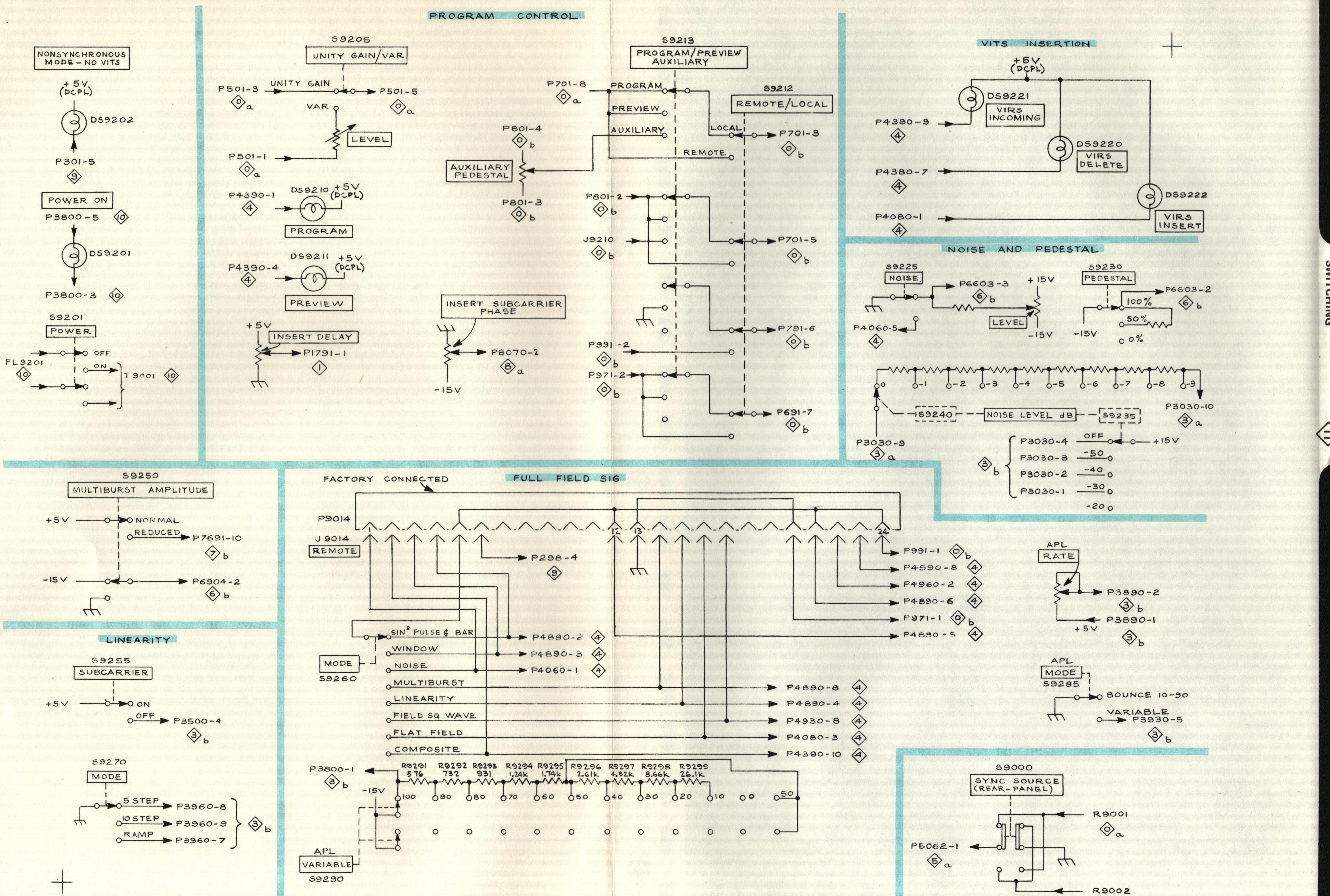
P9850-1	gry on wht
2	blk on vio
3	blk-wht on vio
4	blk-wht on vio
5	blu on wht
6	brn-blu on gry
7	brn-grn on gry

P9852-1	blk on vio
2	
3	blk on vio
4	blk on vio
5	blk on vio
6	blk on vio
7	blk on vio
8	blk on vio
9	blk on vio
10	blk on vio



POWER SUPPLY 10

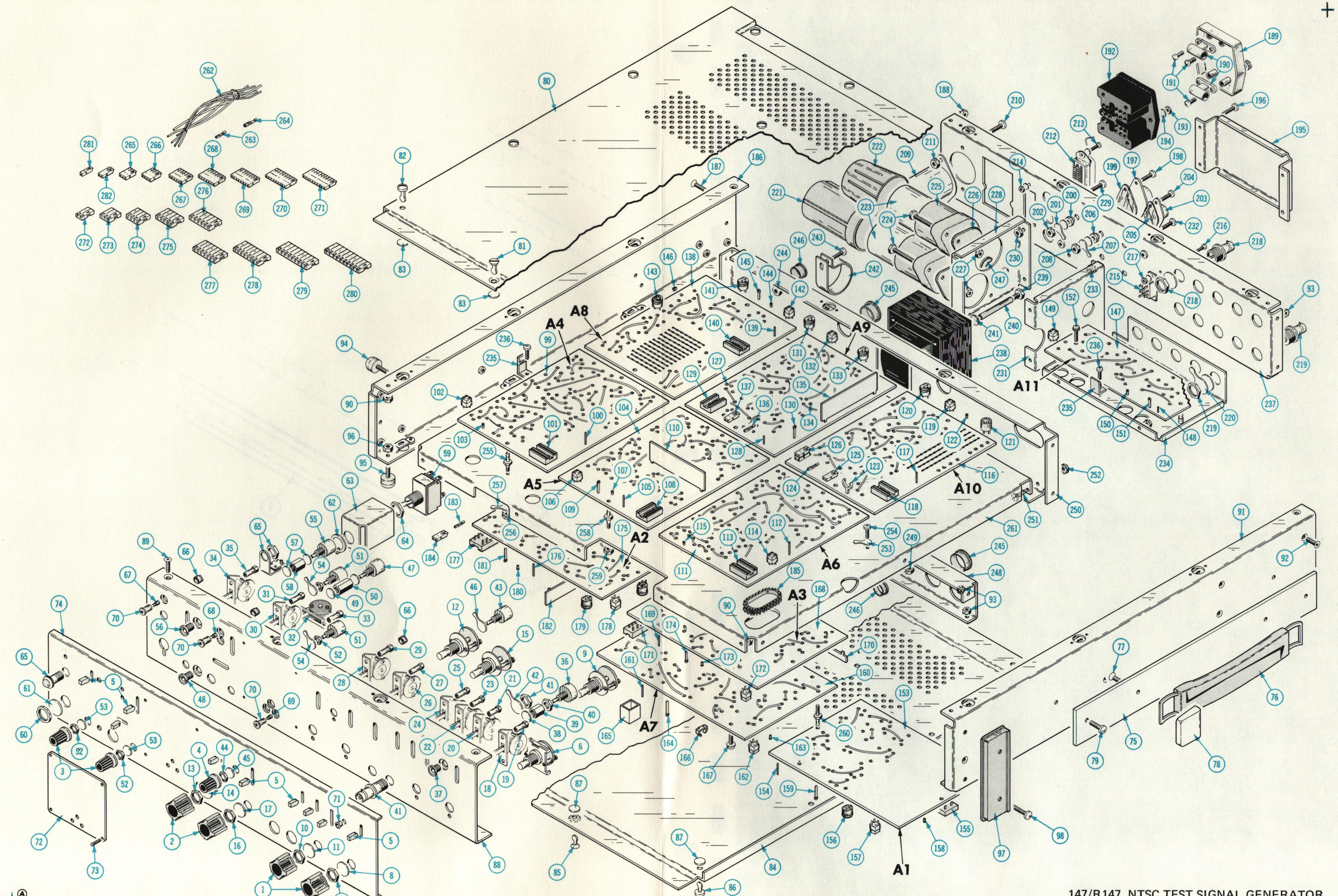
1072
RHL



147/R147

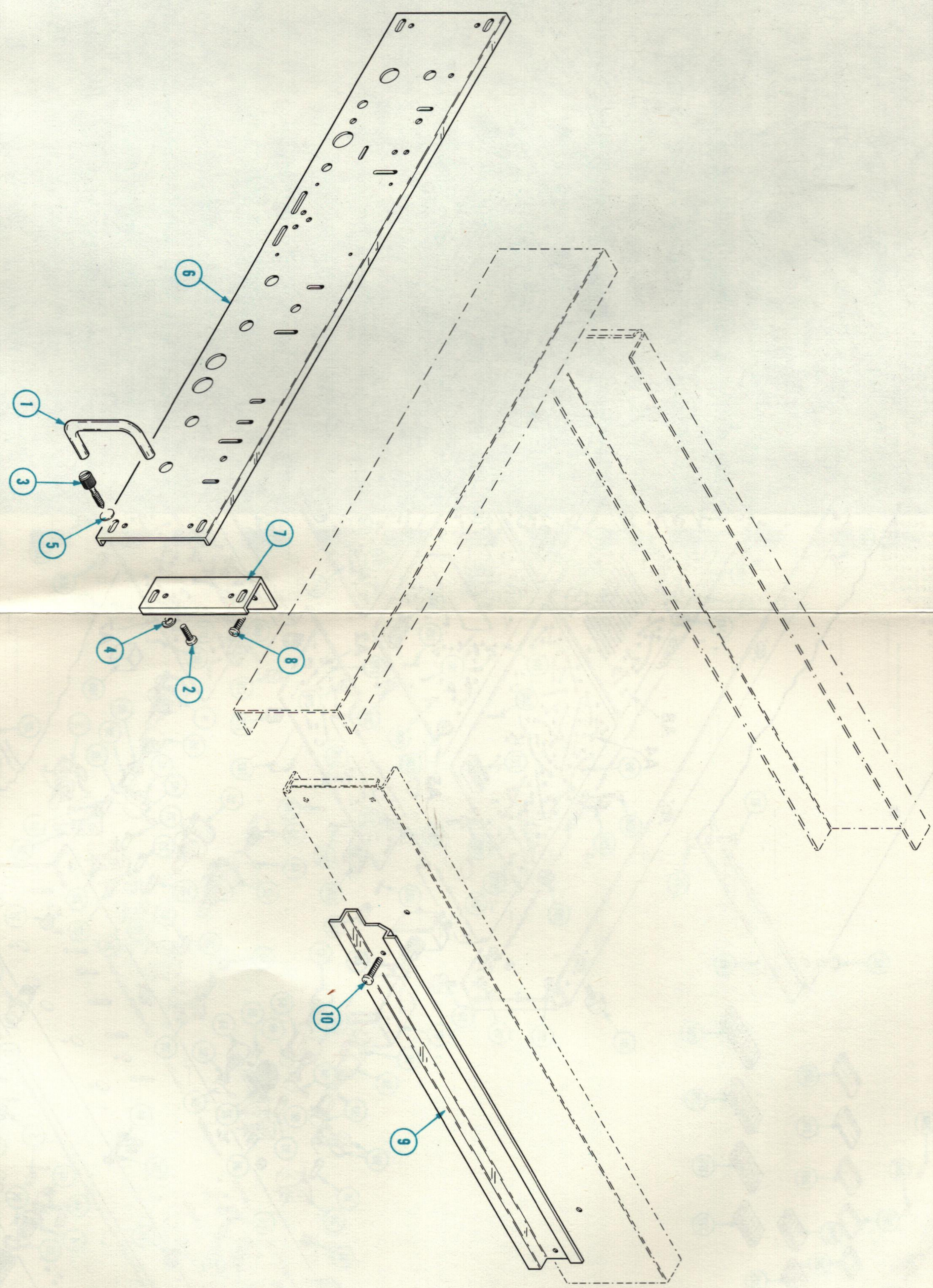
Ⓐ1

SWITCHING ⑪ 971 BC/RL



147/R147 NTSC TEST SIGNAL GENERATOR

FIG. 1 EXPLODED


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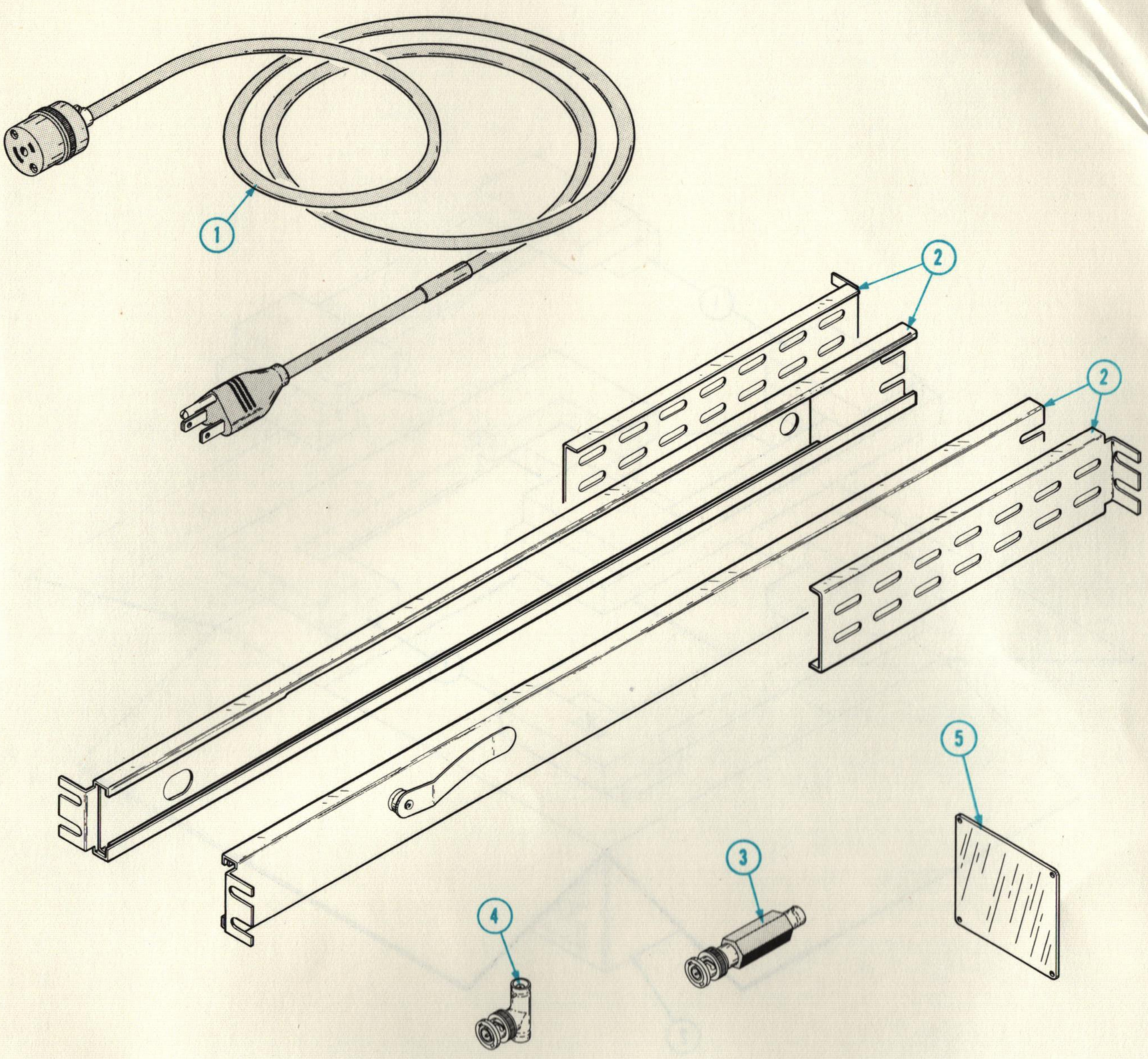


Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
3-1	161-0036-00			1	CABLE ASSEMBLY, power, 3 wire, 7.50 feet long
-2	351-0195-00			1	TRACK, slide, pair (rackmount only)
-3	011-0103-02			1	TERMINATION, 25Ω, BNC
-4	103-0030-00			2	ADAPTER, BNC T male to 2 female
-5	200-1246-00			1	COVER, front panel
	070-1169-00			1	MANUAL, instruction (not shown)

SECTION 8
MECHANICAL PARTS LIST

Replacement parts should be ordered from the Tektronix Field Office or Representative in your area. Changes to Tektronix products give you the benefit of improved circuits and components. Please include the instrument type number and serial number with each order for parts or service.

ABBREVIATIONS

BHB	binding head brass	h	height or high	OHB	oval head brass
BHS	binding head steel	hex.	hexagonal	OHS	oval head steel
CRT	cathode-ray tube	HHB	hex head brass	PHB	pan head brass
csk	countersunk	HHS	hex head steel	PHS	pan head steel
DE	double end	HSB	hex socket brass	RHS	round head steel
FHB	flat head brass	HSS	hex socket steel	SE	single end
FHS	flat head steel	ID	inside diameter	THB	truss head brass
Fil HB	fillister head brass	lg	length or long	THS	truss head steel
Fil HS	fillister head steel	OD	outside diameter	w	wide or width

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-1	366-0500-00			2	KNOB, gray--APL VARIABLE & FULL FIELD SIGNAL
	------			-	each knob includes:
	213-0153-00			2	SETSCREW, 5-40 x 0.125 inch, HSS
-2	366-0500-00			2	KNOB, gray--NOISE LEVEL dB
	------			-	each knob includes:
	213-0153-00			2	SETSCREW, 5-40 x 0.125 inch, HSS
-3	366-1189-00			2	KNOB, gray--LEVEL & AUXILIARY PEDESTAL
	------			-	each knob includes:
	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch, HSS
-4	366-1189-00			1	KNOB, gray--VARIABLE
	------			-	knob includes:
	213-0153-00			1	SETSCREW, 5-40 x 0.125 inch HSS
-5	366-0215-02			10	KNOB, lever, switch
-6	260-1088-00			1	SWITCH, rotary--APL VARIABLE, unwired
	------			-	mounting hardware: (not included w/switch)
-7	210-0590-00			1	NUT, Hex., 0.375-32 x 0.438 inch
-8	210-0978-00			1	WASHER, flat, 0.375 ID x 0.50 inch OD
-9	260-1250-00			1	SWITCH, rotary--FULL FIELD SIGNAL
	------			-	mounting hardware: (not included w/switch)
-10	210-0590-00			1	NUT, hex., 0.375-32 x 0.438 inch
-11	210-0978-00			1	WASHER, flat, 0.375 ID x 0.50 inch OD
-12	260-1252-00			1	SWITCH, rotary--NOISE LEVEL dB, 5 position
	------			-	mounting hardware: (not included w/switch)
-13	210-0590-00			1	NUT, hex., 0.375-32 x 0.438 inch
-14	210-0978-00			1	WASHER, flat, 0.375 ID x 0.50 inch OD
-15	260-1251-00			1	SWITCH, rotary--NOISE LEVEL dB, 10 position
	------			-	mounting hardware: (not included w/switch)
-16	210-0590-00			1	NUT, hex., 0.375-32 x 0.438 inch
-17	210-0978-00			1	WASHER, flat, 0.375 ID x 0.50 inch OD

FIGURE 1 EXPLODED

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
-18	260-0731-00			1	SWITCH, lever--BOUNCE & VARIABLE
	- - - - - -			-	mounting hardware: (not included w/switch)
-19	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long
-20	260-0621-00			1	SWITCH, lever--LINEARITY MODE
	- - - - - -			-	mounting hardware: (not included w/switch)
-21	220-0413-00			2	NUT, switch, mounting, 4-40 x 0.188 x 0.562 inch long
-22	260-0731-00			1	SWITCH, lever--LINEARITY SUBCARRIER
	- - - - - -			-	mounting hardware: (not included w/switch)
-23	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long
-24	260-0664-00			1	SWITCH, lever--MULTIBURST AMPLITUDE
	- - - - - -			-	mounting hardware: (not included w/switch)
-25	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long
-26	260-0621-00			1	SWITCH, lever--PEDESTAL
	- - - - - -			-	mounting hardware: (not included w/switch)
-27	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long
-28	260-0731-00			1	SWITCH, lever--NOISE
	- - - - - -			-	mounting hardware: (not included w/switch)
-29	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long
-30	260-1248-00			1	SWITCH, lever--PROGRAM/PREVIEW/AUX
	- - - - - -			-	mounting hardware: (not included w/switch)
-31	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long
-32	260-1249-00			1	SWITCH, lever--REMOTE/LOCAL
	- - - - - -			-	mounting hardware: (not included w/switch)
-33	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long
-34	260-0731-00			1	SWITCH, lever--UNITY GAIN/VARIABLE
	- - - - - -			-	mounting hardware: (not included w/switch)
-35	220-0413-00			2	NUT, switch mounting, 4-40 x 0.188 x 0.562 inch long
-36	- - - - - -			1	RESISTOR, variable
	- - - - - -			-	mounting hardware: (not included w/resistor)
-37	358-0422-00			1	BUSHING, 0.25-32 x 0.187 inch long
-38	210-0046-00			1	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-39	220-0484-00			1	NUT, hex., 0.25-32 x 0.312 x 0.375 inch long
-40	210-0465-00			1	NUT, hex., 0.25-32 x 0.375 inch

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
-41	131-0106-02			2	CONNECTOR, receptacle, female BNC, w/hardware
	------			-	mounting hardware for each: (not included w/connector)
-42	210-0255-00			1	TERMINAL, lug, 0.391 inch ID, SE
-43	-------			1	RESISTOR, variable
	-------			-	mounting hardware: (not included w/resistor)
-44	210-0583-00			1	NUT, hex., 0.25-32 x 0.312 inch
-45	210-0940-00			1	WASHER, flat, 0.25 ID, 0.375 inch OD
-46	210-0223-00			1	TERMINAL, lug, 0.25 inch diameter, SE
-47	-------			1	RESISTOR, variable
	-------			-	mounting hardware: (not included w/resistor)
-48	358-0409-00			1	BUSHING, 0.25-32 x 0.207 inch long
-49	210-0046-00			2	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-50	210-0471-00			1	POST, hex., 0.25-32 x 0.312 x 0.594 inch long
-51	-------			2	RESISTOR, variable
				-	mounting hardware for each: (not included w/resistor)
-52	210-0583-00			2	NUT, hex., 0.25-32 x 0.312 inch
-53	210-0940-00			2	WASHER, flat, 0.25 ID x 0.375 inch OD
-54	210-0223-00			1	TERMINAL, lug, 0.25 inch diameter, SE
-55	-------			1	RESISTOR, variable
	-------			-	mounting hardware: (not included w/resistor)
-56	358-0422-00			1	BUSHING, 0.25-32 x 0.187 inch long
-57	210-0046-00			2	WASHER, lock, internal, 0.261 ID x 0.40 inch OD
-58	220-0484-00			1	NUT, hex., 0.25-32 x 0.312 x 0.375 inch long
-59	260-0276-00			1	SWITCH, toggle--POWER
	-------			-	mounting hardware: (not included w/switch)
-60	210-0473-00			1	NUT, dodecagon, 0.468-32 x 0.638 inch
-61	210-0902-00			1	WASHER, flat, 0.47 ID x 0.656 inch OD
-62	354-0055-00			1	RING, locking
-63	337-1155-00			1	SHIELD, switch
-64	210-0414-00			1	NUT, hex., 0.468-32 x 0.562 inch
-65	136-0079-00			1	SOCKET ASSEMBLY, w/green jewel & hardware
-66	200-0935-00			6	CAP, lampholder
-67	378-0602-02			2	LENS, indicator light, red
-68	378-0602-01			2	LENS, indicator light, amber
-69	378-0602-00			2	LENS, indicator light, green
-70	352-0157-01			6	LAMPHOLDER
-71	358-0301-00			3	BUSHING, sleeve, plastic

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
-72	333-1458-00			1	PANEL, vits insertion
	- - - - - -			-	mounting hardware: (not included w/panel)
-73	211-0107-00			4	SCREW, 1-72 x 0.312 inch, RHS
-74	333-1433-00[1]			1	PANEL, front
-75	386-1663-00[1]			1	PLATE, handle mounting
	- - - - - -			-	plate includes:
-76	367-0037-00			1	HANDLE
	- - - - - -			-	mounting hardware: (not included w/handle)
-77	212-0506-00			2	SCREW, 10-32 x 0.375 inch, 100° csk, FHS
-78	344-0098-00			2	CLIP
	- - - - - -			-	mounting hardware: (not included w/plate)
-79	212-0507-00			2	SCREW, 10-32 x 0.375 inch, PHS
-80	390-0112-00			1	CABINET TOP
	- - - - - -			-	cabinet top includes:
-81	355-0134-00			2	STUD, turnlock fastener, FHS
-82	355-0135-00			12	STUD, turnlock fastener, OHS
-83	214-0389-00			14	FASTENER, retainer
-84	390-0063-00			1	CABINET BOTTOM
	- - - - - -			-	cabinet bottom includes:
-85	355-0134-00			2	STUD, turnlock fastener, FHS
-86	355-0135-00			12	STUD, turnlock fastener, OHS
-87	214-0389-00			14	FASTENER, retainer
-88	386-1987-00			1	SUBPANEL, front
	- - - - - -			-	mounting hardware: (not included w/subpanel)
-89	211-0538-00			4	SCREW, 6-32 x 0.312 inch, 100° csk, FHS
-90	210-0457-00			9	NUT, keps, 6-32 x 0.312 inch
-91	390-0065-00			1	CABINET SIDE, right
	- - - - - -			-	mounting hardware: (not included w/cabinet side)
-92	211-0538-00			7	SCREW, 6-32 x 0.312 inch, 100° csk, FHS
-93	210-0457-00			7	NUT, keps, 6-32 x 0.312 inch
-94	348-0048-00			4	FOOT, rubber
-95	348-0048-00			4	FOOT, rubber
	- - - - - -			-	mounting hardware for each: (not included w/foot)
-96	210-0457-00			1	NUT, keps, 6-32 x 0.312 inch
-97	124-0216-00[1]			2	STRIP, trim, plastic
	- - - - - -			-	mounting hardware for each: (not included w/strip)
-98	212-0068-00			4	SCREW, 8-32 x 0.312 inch, THS

[1] 147 only.

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FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
1-99	670-1471-00			1	CIRCUIT BOARD ASSEMBLY--HORIZONTAL TIMING A4
	- - - - - -			-	circuit board assembly includes:
	388-2022-00			1	CIRCUIT BOARD
-100	131-0608-00			438	TERMINAL, pin, 0.365 inch long
-101	136-0269-00			20	SOCKET, integrated circuit, 14 pin
-102	136-0220-00	B010100	B010145	1	SOCKET, transistor, 3 pin, square
	136-0252-04	B010146		51	SOCKET, pin connector
-103	136-0252-04	B010100	B010145	48	SOCKET, pin connector
-104	670-1474-00			1	CIRCUIT BOARD ASSEMBLY--APL STAIRCASE NOISE A5
	- - - - - -			-	circuit board assembly includes:
	388-2025-00			1	CIRCUIT BOARD
-105	131-0608-00			78	TERMINAL, pin, 0.365 inch long
-106	136-0220-00	B010100	B010145	33	SOCKET, transistor, 3 pin, square
	136-0220-00	B070000		4	SOCKET, transistor, 3 pin, square
-107	136-0252-04	B010146	B069999	99	SOCKET, pin connector
	136-0252-04	B070000		87	SOCKET, pin connector
	136-0333-00			1	SOCKET, connector pin
-108	136-0269-00			8	SOCKET, integrated circuit, 14 pin
-109	214-0579-00			4	PIN, test point
-110	337-1456-00			2	SHIELD, electrical
	337-1512-00			1	SHIELD, electrical
-111	670-1469-00			1	CIRCUIT BOARD ASSEMBLY--VIT & FULL FIELD A6
	- - - - - -			-	circuit board assembly includes:
	388-2020-00			1	CIRCUIT BOARD
-112	131-0608-00			187	TERMINAL, pin, 0.365 inch long
	131-0589-00			90	TERMINAL, pin, 0.50 inch long
-113	136-0269-00			18	SOCKET, integrated circuit, 14 pin
-114	136-0220-00	B010100	B010145	8	SOCKET, transistor, 3 pin, square
	136-0252-04	B010146		48	SOCKET, pin connector
-115	136-0252-04	B010100	B010145	24	SOCKET, pin connector
-116	670-1475-00	B010100	B019999	1	CIRCUIT BOARD ASSEMBLY--MODULATOR A10
	670-1475-01	B020000	B049999	1	CIRCUIT BOARD ASSEMBLY--MODULATOR A10
	670-1475-02	B050000		1	CIRCUIT BOARD ASSEMBLY--MODULATOR A10
	- - - - - -			-	circuit board assembly includes:
	388-2026-00			1	CIRCUIT BOARD
-117	131-0589-00			53	TERMINAL, pin, 0.50 inch long
	131-0608-00			7	TERMINAL, pin, 0.365 inch long
-118	136-0269-00			3	SOCKET, integrated circuit, 14 pin
-119	136-0220-00	B010100	B010145	29	SOCKET, transistor, 3 pin, square
-120	136-0235-00			2	SOCKET, transistor, 6 pin
-121	136-0241-00			1	SOCKET, integrated circuit, 10 pin
-122	136-0252-04	B010146	B069999	109	SOCKET, pin connector
	136-0252-04	B070000		87	SOCKET, pin connector
-123	352-0134-00			2	HOLDER, toroid
-124	131-0707-00			6	CONNECTOR, terminal
-125	352-0169-03			1	HOLDER, terminal connector, 2 wire (orange)
-126	352-0176-00			1	HOLDER, terminal connector, 2 + 2 wire (black)
-127	670-1476-00	B010100	B019999	1	CIRCUIT BOARD ASSEMBLY--OUTPUT AMP A9
	670-1476-01	B020000		1	CIRCUIT BOARD ASSEMBLY--OUTPUT AMP A9
	- - - - - -			-	circuit board assembly includes:
	388-2027-00			1	CIRCUIT BOARD
-128	131-0589-00			52	TERMINAL, pin, 0.50 inch long
	131-0608-00			9	TERMINAL, pin, 0.365 inch long
-129	136-0269-00			1	SOCKET, integrated circuit, 14 pin
	136-0352-00	XB020526		32	SOCKET, PIN CONNECTOR (COIL MTG)

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
1-130	214-0579-00			3	PIN, test point
-131	136-0183-00	B010100	B010145	2	SOCKET, transistor, 3 pin
-132	136-0220-00	B010100	B010145	21	SOCKET, transistor, 3 pin, square
-133	136-0235-00	B010100	B010145	2	SOCKET, transistor, 6 pin
-134	136-0252-04	B010146		89	SOCKET, pin connector
-135	337-1456-00			3	SHIELD, electrical
-136	131-0707-00			6	CONNECTOR, terminal
-137	352-0169-07			1	HOLDER, terminal connector, 2 wire (violet)
	352-0169-08			2	HOLDER, terminal connector, 2 wire (gray)
-138	670-1470-00	B010100	B019999	1	CIRCUIT BOARD ASSEMBLY--FUNCTION GEN A8
	670-1470-01	B020000		1	CIRCUIT BOARD ASSEMBLY--FUNCTION GEN A8
	- - - - - -			-	circuit board assembly includes:
	388-2021-00			1	CIRCUIT BOARD
-139	131-0589-00			38	TERMINAL, pin, 0.50 inch long
	131-0608-00			6	TERMINAL, pin, 0.365 inch long
-140	136-0269-00			1	SOCKET, integrated circuit, 14 pin
-141	136-0183-00	B010100	B010145	4	SOCKET, transistor, 3 pin
-142	136-0220-00	B010100	B010145	37	SOCKET, transistor, 3 pin, square
-143	136-0235-00			2	SOCKET, transistor, 6 pin
-144	136-0252-04	B010146	B069999	135	SOCKET, pin connector
	136-0252-04	B070000		123	SOCKET, pin connector
-145	214-0579-00			1	PIN, test point
-146	344-0108-00			8	CLIP, electrical
-147	670-1473-00	B010100	B039999	1	CIRCUIT BOARD ASSEMBLY--POWER SUPPLY A11
	670-1473-01	B040000		1	CIRCUIT BOARD ASSEMBLY--POWER SUPPLY A11
	- - - - - -			-	circuit board assembly includes:
	388-2024-00	B010100	B039999	1	CIRCUIT BOARD
	388-2024-01	B040000		1	CIRCUIT BOARD
-148	131-0589-00			57	TERMINAL, pin, 0.50 inch long
-149	136-0220-00	B010100	B010145	12	SOCKET, transistor, 3 pin, square
-150	136-0242-04	B010146		36	SOCKET, pin connector
-151	214-0579-00			4	PIN, test point
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
-152	211-0116-00			2	SCREW, sems, 4-40 x 0.312 inch, PHB
-153	670-1477-00			1	CIRCUIT BOARD ASSEMBLY--SUBCARRIER & SYNC A1
	- - - - - -			-	circuit board assembly includes:
	388-2028-00			1	CIRCUIT BOARD
-154	131-0589-00			41	TERMINAL, pin, 0.50 inch long
-155	136-0269-00			4	SOCKET, integrated circuit, 14 pin
-156	136-0183-00	B010100	B010145	1	SOCKET, transistor, 3 pin
-157	136-0220-00	B010100	B010145	17	SOCKET, transistor, 3 pin, square
-158	136-0252-04	B010146		62	SOCKET, pin connector
	136-0252-04	B010100	B010145	8	SOCKET, pin connector
-159	214-0579-00			1	PIN, test point
-160	670-1487-00			1	CIRCUIT BOARD ASSEMBLY--GEN LOCK A7
	- - - - - -			-	circuit board assembly includes:
	388-2040-00			1	CIRCUIT BOARD
-161	131-0589-00			20	TERMINAL, pin, 0.50 inch long
	131-0608-00			3	TERMINAL, pin, 0.365 inch long
-162	136-0220-00	B010100	B010145	66	SOCKET, transistor, 3 pin, square
-163	136-0252-04	B010146		198	SOCKET, pin connector
	136-0234-00			2	RECEPTACLE, electrical

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-164	214-0579-00			16	PIN, test point
-165	337-1417-00			1	SHIELD, electrical
-166	352-0096-00			1	CRYSTALHOLDER
	- - - - - -			-	mounting hardware: (not included w/circuit board assembly)
-167	211-0116-00			4	SCREW, sems, 4-40 x 0.312 inch, PHB
-168	670-1472-00			1	CIRCUIT BOARD ASSEMBLY--VERTICAL COUNTER A3
	- - - - - -			-	circuit board assembly includes:
	388-2023-00			1	CIRCUIT BOARD
-169	131-0589-00			42	TERMINAL, pin, 0.50 inch long
-170	131-0998-00			5	BUS BAR, 9-terminal, 0.375 x 8.132 inches long
-171	136-0269-00			18	SOCKET, integrated circuit, 14 pin
-172	136-0220-00	B010100	B010145	18	SOCKET, transistor, 3 pin, square
-173	136-0252-04	B010146		54	SOCKET, pin connector
-174	214-0579-00			16	PIN, test point
-175	670-1468-00	B010100	B069999	1	CIRCUIT BOARD ASSEMBLY--VIT INSERTION A2
	670-1468-01	B070000		1	CIRCUIT BOARD ASSEMBLY--VIT INSERTION A2
	- - - - - -			-	circuit board assembly includes:
	388-2019-00	B010100	B069999	1	CIRCUIT BOARD
	388-2019-01	B070000		1	CIRCUIT BOARD
	131-0566-00			1	LINK, terminal connecting
-176	131-0589-00	B010100	B069999	60	TERMIANL, pin, 0.50 inch long
	131-0589-00	B060000		66	TERMINAL, pin, 0.46 inch long
	131-0608-00	B010100	B069999	9	TERMINAL, pin, 0.50 inch long
	131-0608-00	B070000		6	TERMINAL, pin, 0.365 inch long
-177	136-0260-01			2	SOCKET, integrated circuit, 16 pin
-178	136-0220-00	B010100	B010145	28	SOCKET, transistor, 3 pin, square
-179	136-0235-00			1	SOCKET, transistor, 6 pin
	136-0337-00	B010100	B010145	1	SOCKET, relay, 8 pin (not shown)
-180	136-0252-04	B010146	B069999	98	SOCKET, pin connector
	136-0252-04	B070000		96	SOCKET, pin connector
-181	214-0579-00	B010100	B069999	9	PIN, test point
	214-0579-00	B070000		7	PIN, test point
-182	337-1456-00			1	SHIELD, electrical
-183	131-0707-00			2	CONNECTOR, terminal
-184	352-0169-00			1	HOUSING, terminal connector, 2 wire (black)
-185	255-0334-00			ft	PLASTIC CHANNEL, 10.875 inches long
-186	390-0066-00			1	CABINET SIDE, left
	- - - - - -			-	mounting hardware: (not included w/cabinet side)
-187	211-0538-00			7	SCREW, 6-32 x 0.312 inch, 100° csk, FHS
-188	210-0457-00			7	NUT, keps, 6-32 x 0.312 inch
-189	200-0762-00			1	COVER, line voltage selector
	- - - - - -			-	cover includes:
-190	352-0102-00			2	FUSEHOLDER, plastic
	- - - - - -			-	mounting hardware for each: (not included w/fuseholder)
-191	213-0088-00			2	SCREW, thread forming, 4-40 x 0.25 inch, PHS
-192	204-0279-00			1	BODY, line voltage selector
	- - - - - -			-	mounting hardware: (not included w/body)
-193	210-0407-00			2	NUT, hex., 6-32 x 0.25 inch
-194	210-0006-00			2	WASHER, lock, internal, 0.146 ID x 0.283 inch OD

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	1 2 3 4 5 Description
1-195	200-0918-03			1	COVER, transistor
	- - - - - - -			-	mounting hardware: (not included w/cover)
-196	211-0008-00			4	SCREW, 4-40 x 0.25 inch, PHS
-197	- - - - - - -			2	TRANSISTOR
	- - - - - - -			-	mounting hardware for each: (not included w/transistor)
-198	211-0510-00			2	SCREW, 6-32 x 0.375 inch, PHS
-199	386-0978-00			1	PLATE, insulator
-200	210-0975-00			2	WASHER, plastic, shouldered, 0.14 ID x 0.375 inch OD
	210-0803-00			2	WASHER, flat, 0.15 ID x 0.375 inch OD
-201	210-0202-00			1	LUG, solder, SE #6
-202	210-0457-00			2	NUT, keps, 6-32 x 0.312 inch
-203	- - - - - - -			1	TRANSISTOR
	- - - - - - -			-	mounting hardware: (not included w/transistor)
-204	211-0510-00			2	SCREW, 6-32 x 0.375 inch, PHS
-205	386-0143-00			1	PLATE, insulator
-206	210-0935-00			2	WASHER, fiber, shouldered, 0.14 ID x 0.375 inch OD
	210-0803-00			2	WASHER, flat, 0.15 ID x 0.375 inch OD
-207	210-0202-00			1	LUG, solder, SE #6
-208	210-0457-00			2	NUT, keps, 6-32 x 0.312 inch
-209	119-0095-06			1	LINE FILTER
	- - - - - - -			-	mounting hardware: (not included w/line filter)
-210	211-0507-00			2	SCREW, 6-32 x 0.312 inch, PHS
-211	210-0457-00			2	NUT, keps, 6-32 x 0.312 inch
-212	131-0324-00			1	CONNECTOR, 24 pin female
	- - - - - - -			-	mounting hardware: (not included w/connector)
-213	211-0062-00			2	SCREW, 2-56 x 0.312 inch, PHS
	210-0001-00			2	WASHER, lock, internal, 0.092 ID x 0.18 inch OD
-214	210-0405-00			2	NUT, hex., 2-56 x 0.188 inch
-215	260-0583-01			1	SWITCH, slide--SYNC SOURCE
	- - - - - - -			-	mounting hardware: (not included w/switch)
-216	211-0022-00			2	SCREW, 2-56 x 0.188 inch, PHS
	210-0001-00			2	WASHER, lock, internal, 0.092 ID x 0.18 inch OD
-217	210-0405-00			2	NUT, hex., 2-56 x 0.188 inch
-218	131-0274-00			1	CONNECTOR, BNC, insulated, w/hardware
-219	131-0126-00			12	CONNECTOR, receptacle, BNC, female, w/hardware
	- - - - - - -			-	mounting hardware for each: (not included w/connector)
-220	210-0241-00			1	LUG, terminal, 0.515 ID x 0.625 inch OD, SE

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-221	200-0293-00			1	COVER, capacitor, 1.365 ID x 2.562 inches long
-222	200-0538-00			1	COVER, capacitor, 1.365 ID x 1.644 inches long
-223	- - - - - - -			2	CAPACITOR
	- - - - - - -			-	mounting hardware for each: (not included w/capacitor)
-224	211-0588-00			2	SCREW, 6-32 x 0.75 inch, HHS
-225	432-0048-00			1	BASE, capacitor mounting
-226	386-0254-00			1	PLATE, fiber, large
-227	210-0457-00			2	NUT, keps, 6-32 x 0.312 inch
-228	407-0556-00			1	BRACKET, capacitor
	- - - - - - -			-	mounting hardware: (not included w/bracket)
-229	211-0507-00			4	SCREW, 6-32 x 0.312 inch, PHS
-230	210-0457-00			4	NUT, keps, 6-32 x 0.312 inch
-231	386-1487-00			1	SUPPORT, bracket
	- - - - - - -			-	mounting hardware: (not included w/bracket)
-232	211-0507-00			4	SCREW, 6-32 x 0.312 inch, PHS
	210-0202-00			1	LUG, solder, SE #6
-233	210-0457-00			4	NUT, keps, 6-32 x 0.312 inch
-234	441-0892-00			1	CHASSIS
	- - - - - - -			-	mounting hardware: (not included w/chassis)
	211-0504-00			2	SCREW, 6-32 x 0.25 inch, PHS, (not shown)
	210-0457-00			2	NUT, keps, 6-32 x 0.312 inch (not shown)
-235	344-0133-00			48	CLIP, circuit board
	- - - - - - -			-	mounting hardware for each: (not included w/clip)
-236	213-0138-00			1	SCREW, thread forming, 6-24 x 0.188 inch, PHS
-237	386-1986-00			1	PANEL, rear
-238	- - - - - - -			1	TRANSFORMER
	- - - - - - -			-	mounting hardware: (not included w/transformer)
-239	212-0516-00			4	SCREW, 10-32 x 2 inches, HHS
-240	166-0227-00			4	TUBE, insulating, plastic
-241	210-0812-00			4	WASHER, fiber 0.188 ID x 0.375 inch OD
	220-0410-00			4	NUT, keps, 10-32 x 0.375 inch, (not shown)
-242	343-0320-00			1	CLAMP, loop
	- - - - - - -			-	mounting hardware: (not included w/clamp)
-243	211-0507-00			1	SCREW, 6-32 x 0.312 inch, PHS
-244	210-0457-00			1	NUT, keps, 6-32 x 0.312 inch

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-245	348-0050-00			7	GROMMET, plastic, 0.75 inch diameter
-246	348-0063-00			4	GROMMET, plastic, 0.50 inch diameter
-247	348-0064-00			1	GROMMET, plastic, 0.625 inch diameter
-248	386-1532-00			1	SUPPORT, chassis
	- - - - - -			-	mounting hardware: (not included w/support)
-249	210-0457-00			3	NUT, keps, 6-32 x 0.312 inch
-250	407-0555-00			1	BRACKET, transformer
	- - - - - -			-	mounting hardware: (not included w/support)
-251	211-0507-00			4	SCREW,6-32 x 0.312 inch, PHS
-252	210-0457-00			3	NUT, keps, 6-32 x 0.312 inch
-253	210-0201-00			7	LUG, solder, SE #4
	- - - - - -			-	mounting hardware for each: (not included w/lug)
-254	213-0044-00			1	SCREW, thread forming, 5-32 x 0.188 inch, PHS
-255	214-1169-00			7	PIN, guide, 0.80 inch long
	- - - - - -			-	mounting hardware for each: (not included w/guide)
-256	210-0457-00			1	NUT, keps, 6-32 x 0.312 inch
-257	210-0202-00			1	LUG, solder, SE #6
-258	214-1169-00			5	PIN, guide, 0.80 inch long
	- - - - - -			-	mounting hardware: (not included w/pin)
-259	210-0457-00			1	NUT, keps, 6-32 x 0.312 inch
-260	214-1621-00			6	PIN, guide, 0.74 inch long
	- - - - - -			-	mounting hardware for each: (not included w/pin)
	210-0457-00			1	NUT, keps, 6-32 x 0.312 inch
-261	441-1008-00			1	CHASSIS, main
-262	179-1684-00	B010100	B069999	1	WIRING HARNESS, chassis
	179-1684-01	B070000		1	WIRING HARNESS, chassis
	- - - - - -			-	wiring harness includes:
-263	131-0707-00			96	CONNECTOR, terminal
	131-0708-00			14	CONNECTOR, terminal
	131-0792-00			28	CONNECTOR, terminal
-264	131-0621-00			232	CONNECTOR, terminal
	131-0622-00			39	CONNECTOR, terminal
-265	352-0161-00			3	HOLDER, terminal connector, 3 wire (black)
-266	352-0162-00			2	HOLDER, terminal connector, 4 wire (black)
-267	352-0164-00			1	HOLDER, terminal connector, 6 wire (black)
-268	352-0165-00			2	HOLDER, terminal connector, 7 wire (black)
-269	362-0166-00			7	HOLDER, terminal connector, 8 wire (black)
-270	352-0167-00			2	HOLDER, terminal connector, 9 wire (black)
-271	352-0168-00			2	HOLDER, terminal connector, 10 wire (black)

FIGURE 1 EXPLODED (cont)

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
1-272	352-0198-00			7	HOLDER, terminal connector, 2 wire (black)
-273	352-0199-00			3	HOLDER, terminal connector, 3 wire (black)
-274	352-0200-00			6	HOLDER, terminal connector, 4 wire (black)
-275	352-0201-00			6	HOLDER, terminal connector, 5 wire (black)
-276	352-0202-00			7	HOLDER, terminal connector, 6 wire (black)
-277	352-0203-00			4	HOLDER, terminal connector, 7 wire (black)
-278	352-0204-00			3	HOLDER, terminal connector, 8 wire (black)
-279	352-0205-00			3	HOLDER, terminal connector, 9 wire (black)
-280	352-0206-00			15	HOLDER, terminal connector, 10 wire (black)
	179-1685-00			1	WIRING HARNESS, power
	- - - - - -			-	wiring harness includes:
	131-0621-00			21	CONNECTOR, terminal
	352-0203-00			2	HOLDER, terminal connector, 7 wire (black)
	352-0205-00			1	HOLDER, terminal connector, 9 wire (black)
	179-1686-00	B010100	B069999	1	WIRING HARNESS, coaxial
	179-1686-01	B070000		1	WIRING HARNESS, coaxial
	- - - - - -			-	wiring harness includes:
	131-0621-00			1	CONNECTOR, terminal
	131-0622-00			5	CONNECTOR, terminal
	131-0792-00			6	CONNECTOR, terminal
	352-0200-00	B010100	B069999	1	HOLDER, terminal connector, 4 wire (black)
	352-0201-00	B070000		1	HOLDER, terminal connector, 5 wire (black)
	352-0203-00	B010100	B069999	1	HOLDER, termanil connector, 7 wire (black)
	352-0206-00	B070000		1	HOLDER, terminal connector, 10 wire (black)
	179-1687-00			1	WIRING HARNESS, AC
	179-1688-00			1	WIRING HARNESS, horizontal timing
	- - - - - -			-	wiring harness includes:
	131-0707-00			136	CONNECTOR, terminal
-281	352-0171-00			29	HOLDER, terminal connector, 1 wire (black)
	352-0171-01			17	HOLDER, terminal connector, 1 wire (brown)
	352-0171-02			10	HOLDER, terminal connector, 1 wire (red)
	352-0171-03			7	HOLDER, terminal connector, 1 wire (orange)
	352-0171-04			4	HOLDER, terminal connector, 1 wire (yellow)
	352-0171-06	XB090000		1	HOLDER, terminal connector, 1 wire (blue)
-282	352-0169-00			1	HOLDER, terminal connector, 2 wire (black)
	352-0164-00			1	HOLDER, terminal connector, 6 wire (black)
	352-0166-00			1	HOLDER, terminal connector, 8 wire (black)
	352-0166-01			1	HOLDER, terminal connector, 8 wire (brown)
	352-0166-02			1	HOLDER, terminal connector, 8 wire (red)
	352-0166-03			1	HOLDER, terminal connector, 8 wire (orange)
	352-0167-00			2	HOLDER, terminal connector, 9 wire (black)
	352-0168-00			1	HOLDER, terminal connector, 10 wire (black)
	670-2327-00	XB070000		1	CIRCUIT BOARD ASSEMBLY--RELAY & DELAY
	- - - - - -			-	circuit board assembly includes:
	388-2862-00			1	CIRCUIT BOARD
	131-0589-00			8	TERMINAL, pin, 0.46 inch long
	136-0252-04			8	SOCKET, pin connector

FIGURE 2 RACKMOUNTING

Fig. & Index No.	Tektronix Part No.	Serial/Model No. Eff	Disc	Qty	Description 1 2 3 4 5
-1	367-0102-00			2	HANDLE, carrying
	- - - - - -			-	mounting hardware for each: (not included w/handle)
-2	212-0004-00			2	SCREW, 8-32 x 0.312 inch, PHS
-3	213-0216-00	B010100	B069999	4	THUMBSCREW, 10-32 x 0.375 inch
	213-0216-00	B070000		2	THUMBSCREW, 10-32 x 0.375 inch
	- - - - - -			-	mounting hardware for each: (not included w/thumbscrew)
-4	354-0025-00			1	RING, retaining
-5	210-0894-00			1	WASHER, plastic, 0.19 ID x 0.438 inch OD
-6	333-1434-00	B010100	B069999	1	PANEL, front
	333-1433-00	B070000		1	PANEL, front
-7	407-0510-00	B010100	B069999X	2	BRACKET, angle
	- - - - - -			-	mounting hardware for each: (not included w/bracket)
-8	212-0004-00			4	SCREW, 8-32 x 0.312 inch, PHS
-9	351-0104-00			1pr	SLIDE, section (pair)
	- - - - - -			-	mounting hardware for each: (not included w/slide)
-10	212-0004-00			2	SCREW, 8-32 x 0.312 inch, PHS
	124-0270-00	XB070000		1	STRIP, trim, right
	124-0270-01	XB070000		1	STRIP, trim, left

MANUAL CHANGE INFORMATION

At Tektronix, we continually strive to keep up with latest electronic developments by adding circuit and component improvements to our instruments as soon as they are developed and tested.

Sometimes, due to printing and shipping requirements, we can't get these changes immediately into printed manuals. Hence, your manual may contain new change information on following pages.

A single change may affect several sections. Sections of the manual are often printed at different times, so some of the information on the change pages may already be in your manual. Since the change information sheets are carried in the manual until ALL changes are permanently entered, some duplication may occur. If no such change pages appear in this section, your manual is correct as printed.

147A EFF SN B110000-up

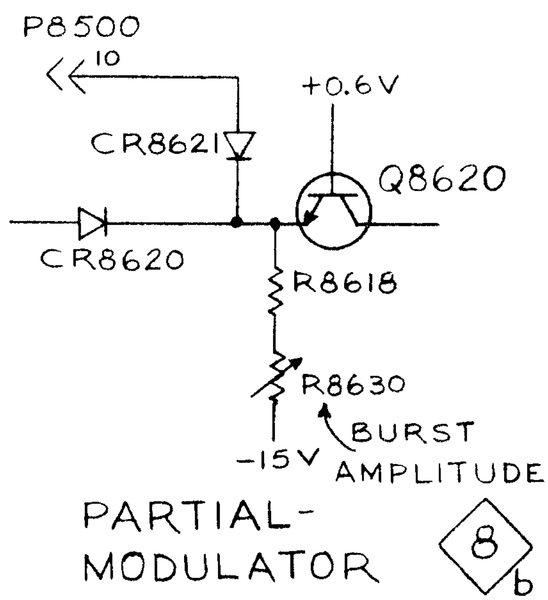
ELECTRICAL PARTS LIST AND SCHEMATIC CHANGE

REMOVE:

CR4572	152-0141-02	Silicon, replaceable by 1N4152

ADD:

CR8621	152-0185-00	Silicon, selected from 1N4152 or 1N3605



ELECTRICAL PARTS LIST AND SCHEMATIC CORRECTION

CHANGE TO:

A6	670-2039-04	FUNCTION GEN Circuit Board Assembly
A8	670-1475-04	MODULATOR Circuit Board Assembly
C6042	281-0613-00	10 pF, Cer, 200 V
C6533	281-0541-00	6.8 pF (nominal value) selected
C6562	281-0510-00	22 pF, Cer, 500 V
C6682	283-0004-00	0.02 μF, Cer, 150 V
CR6013	152-0141-02	Silicon, replaceable by 1N4152
CR6017	152-0141-02	Silicon, replaceable by 1N4152
CR6019	152-0141-02	Silicon, replaceable by 1N4152
CR6022	152-0141-02	Silicon, replaceable by 1N4152
CR6028	152-0141-02	Silicon, replaceable by 1N4152
CR6033	152-0141-02	Silicon, replaceable by 1N4152
CR6037	152-0141-02	Silicon, replaceable by 1N4152
CR6048	152-0141-02	Silicon, replaceable by 1N4152
CR6112	152-0141-02	Silicon, replaceable by 1N4152
CR6114	152-0141-02	Silicon, replaceable by 1N4152
CR6118	152-0141-02	Silicon, replaceable by 1N4152
CR6122	152-0141-02	Silicon, replaceable by 1N4152
CR6128	152-0141-02	Silicon, replaceable by 1N4152
CR6132	152-0141-02	Silicon, replaceable by 1N4152
CR6136	152-0141-02	Silicon, replaceable by 1N4152
CR6306	152-0153-00	Silicon, replaceable by FD7003 or CD5574
CR6308	152-0153-00	Silicon, replaceable by FD7003 or CD5574
CR6316	152-0153-00	Silicon, replaceable by FD7003 or CD5574
CR6318	152-0153-00	Silicon, replaceable by FD7003 or CD5574

CHANGE TO:

CR6331	152-0153-00	Silicon, replaceable by FD7003 or CD5574
CR6335	152-0153-00	Silicon, replaceable by FD7003 or CD5574
CR6338	152-0153-00	Silicon, replaceable by FD7003 or CD5574
CR6344	152-0153-00	Silicon, replaceable by FD7003 or CD5574
CR6464	152-0141-02	Silicon, replaceable by 1N4152
CR6466	152-0141-02	Silicon, replaceable by 1N4152
CR6588	152-0141-02	Silicon, replaceable by 1N4152
CR6603	152-0141-02	Silicon, replaceable by 1N4152
CR6634	152-0141-02	Silicon, replaceable by 1N4152
CR6703	152-0141-02	Silicon, replaceable by 1N4152
CR6709	152-0141-02	Silicon, replaceable by 1N4152
CR6789	152-0141-02	Silicon, replaceable by 1N4152
CR6885	152-0141-02	Silicon, replaceable by 1N4152
CR6913	152-0141-02	Silicon, replaceable by 1N4152
CR6915	152-0141-02	Silicon, replaceable by 1N4152
CR6918	152-0141-02	Silicon, replaceable by 1N4152
CR6920	152-0141-02	Silicon, replaceable by 1N4152
CR6923	152-0141-02	Silicon, replaceable by 1N4152
CR6925	152-0141-02	Silicon, replaceable by 1N4152
CR6966	152-0141-02	Silicon, replaceable by 1N4152
CR6987	152-0141-02	Silicon, replaceable by 1N4152
CR6988	152-0141-02	Silicon, replaceable by 1N4152
Q6103	151-0127-00	Silicon, NPN, selected from 2N2369
R6117	321-0354-00	47.5 kΩ, 1/8 W, 1%
R6119	321-0277-00	7.5 kΩ, 1/8 W, 1%
R6122	321-0279-00	7.87 kΩ, 1/8 W, 1%

CHANGE TO:

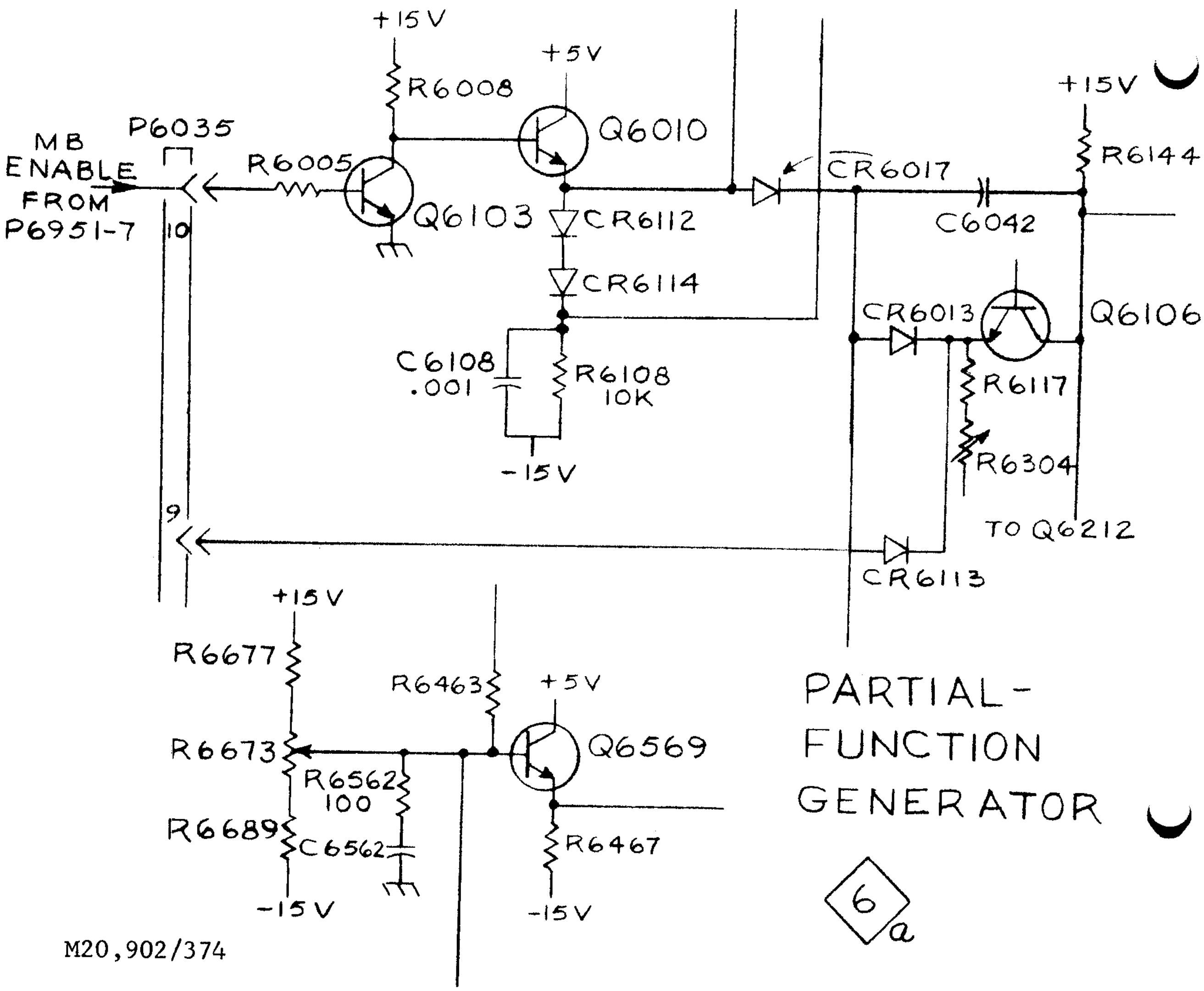
R6128	321-0233-00	2.61 kΩ, 1/8 W, 1%
R6132	321-0247-00	3.65 kΩ, 1/8 W, 1%
R6136	321-0229-00	2.37 kΩ, 1/8 W, 1%
R6142	321-0406-00	165 kΩ, 1/8 W, 1%
R6144	321-0214-00	1.69 kΩ, 1/8 W, 1%
R6158	322-0205-00	1.33 kΩ, 1/4 W, 1%
R6164	323-0176-00	665 Ω, 1/2 W, 1%
R6202	311-1269-00	20 kΩ, Var
R6249	321-0394-00	124 kΩ, 1/8 W, 1%
R6324	311-1267-00	5 kΩ, Var
R6334	311-1266-00	2.5 kΩ, Var
R6892	315-0472-00	4.7 kΩ, 1/4 W, 5%
R6912	321-0251-00	4.02 kΩ, 1/8 W, 1%
R8035	315-0392-00	3.9 kΩ, 1/4 W, 5%
R8060	311-1263-00	1 kΩ, Var
R8188	321-0207-00	1.4 kΩ, 1/8 W, 1%
R8740	321-0201-00	1.21 kΩ, 1/8 W, 1%
R8943	315-0393-00	30 kΩ, 1/4 W, 5%

REMOVE:

C8742	283-0636-00	36 pF, Mica, 100 V
Q6110	151-0190-00	Silicon, NPN, replaceable by 2N3904 or TE3904
Q8455	151-0188-00	Silicon, PNP, replaceable by 2N3906
R6742	315-0183-00	18 kΩ, 1/4 W, 5%
R6841	315-0183-00	18 kΩ, 1/4 W, 5%
R6887	315-0302-00	3 kΩ, 1/4 W, 5%
R8333	315-0122-00	1.2 kΩ, 1/4 W, 5%
R8335	315-0471-00	470 Ω, 1/4 W, 5%

ADD:

C6108	283-0000-00	0.001 μF, Cer, 500 V, +100%-0%
C6508	281-0509-00	15 pF (nominal value) selected
(Added in parallel with R6508 located on diagram 6b)		
C8188	281-0512-00	27 pF, Cer, 500 V, ±2.7 pF
(Added in parallel with CR8188 located on diagram 8a)		
CR6113	152-0141-02	Silicon, replaceable by 1N4152
CR6624	152-0141-02	Silicon, replaceable by 1N4152 (EPL ONLY)
Q6010	151-0190-00	Silicon, NPN, replaceable by 2N3904 (EPL ONLY)
R6562	315-0101-00	100 Ω, 1/4 W, 5%
R6736	311-1271-00	50 kΩ, Var
(Replaces R6841 located on diagram 6b)		
R6981	315-0103-00	10 kΩ, 1/4 W, 5%
(Replaces R6887 located on diagram 6a)		



PARTIAL-FUNCTION GENERATOR

6a

M20,902/374

MECHANICAL PARTS LIST CHANGE

Pages 8-10 and 8-11

CHANGE TO:

Fig. 1-267	179-1684-03	1	WIRING HARNESS, chassis
Fig. 1-277	352-0203-00	3	HOLDER, terminal connector 7 wire (black)

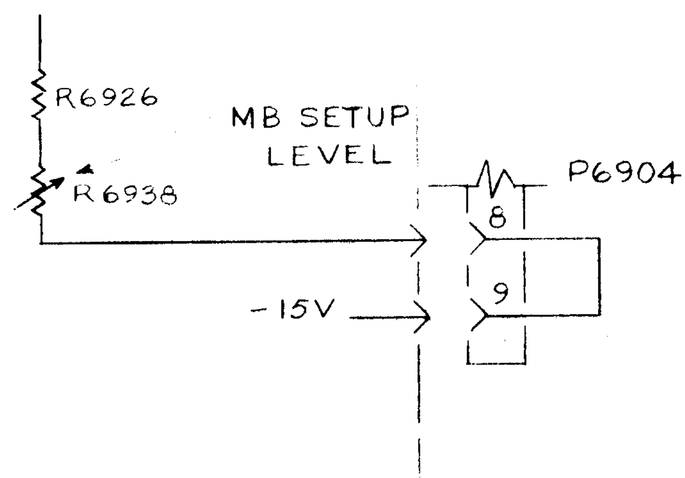
ADD:

	352-0167-00	1	HOLDER, terminal connector 9 wire (black)

SCHEMATIC CHANGE

P6904 changes from a 7 pin connector to a 9 pin connector.

NOISE & MULTIBURST PEDESTAL 6a



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MANUAL CHANGE INFORMATION

PRODUCT 147A/R147A
EFF SN B120000-up

CHANGE REFERENCE M20,902 ADDENDUM
DATE 6-5-74

CHANGE:	DESCRIPTION

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGES

CHANGE TO:

C6508	281-0541-00	6.8 pF (nominal value) Selected
C6533	281-0509-00	15 pF (nominal value) Selected
R8943	315-0303-00	30KΩ, 1/4 W, 5%

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MANUAL CHANGE INFORMATION

PRODUCT 147A/R & 149A/R

CHANGE REFERENCE M22,936

DATE 11-4-74

CHANGE:	DESCRIPTION

EFF SN B121390-up (147A/R)

EFF SN B070830-up (149A/R)

ELECTRICAL PARTS LIST AND SCHEMATIC CHANGE

CHANGE TO:

C5040	283-0167-00	0.1 μF, Cer, 200 V, 10%

MANUAL CHANGE INFORMATION

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PRODUCT 147A/R147A	CHANGE REFERENCE M23276
EFF SN B130000 & up	DATE Dec. 19, 1974

CHANGE:	DESCRIPTION

TEXT CHANGES

Section 1 Specification, Page 1-5

Table 1-2, Ramp Signal, Amplitude

CHANGE Performance Requirement TO:

90 IRE (Adjustable between 80 and 100 IRE)

Page 1-6, Fig. 1-2, RAMP LINEARITY

CHANGE peak level of RAMP signal TO READ:

90

Section 2 Operating Instructions

Page 2-10, Table 2-2

CHANGE TO:

TABLE 2-2

147A FACTORY VITS PROGRAMMING

LINE	FIELD	SIGNAL
17	1	MULTIBURST
17	2	NOISE[3]
18	1	COMPOSITE
18	2	LINEARITY
19	1 & 2	VIRS
20	1 & 2	Open
21	1	Full Line Deletion
21	2	1/2 Line Deletion

[3]NOISE will be displayed in the center half of line 17 only, and will be dealt with later in the procedure.

PRODUCT 147A/R147A CHANGE REFERENCE M23276 DATE Dec. 19, 1974

CHANGE:	DESCRIPTION

NOTE

Where line and field numbers are mentioned (with relation to VITS signals) in the Operating Instructions and Maintenance & Calibration sections of this manual, please refer to the new Table 2-2 for correct information.

TEXT CHANGES

Section 4 Maintenance and Calibration
Page 4-9, Group 7 - Linearity, part c.

CHANGE TO READ:

c. Set R3616 (Ramp Amplitude) for a peak amplitude of 90 IRE.

Page 4-20, Group 7 - Linearity, Step 2-e.

CHANGE TO READ:

e. CHECK - Ramp should be 90 IRE within 1 IRE.

ADJUST - R3616 (Ramp Ampl) for a ramp amplitude of 90 IRE.

Mechanical Parts List Change

Section 8 Mechanical Parts List, Page 8-4, Fig. 1-72

CHANGE TO:

-72 333-1458-07 1 PANEL, vits insertion